Return to Harold Benz
Eval Inst. Lab.
Mail station 626
John TRASK (PIGAN)
537-4501
Dick Weber
866-6981

VARIAN

F-80
X-Y Recorder

S/N 417

RIP

Recorder Division

TECHNICAL INFORMATION

VARIAN associates
PALO ALTO, CALIFORNIA

Preliminary Instruction Manual

F-80
X-Y Recorder

S/N 417

RIP

G-364

Publication Number
87-300-057

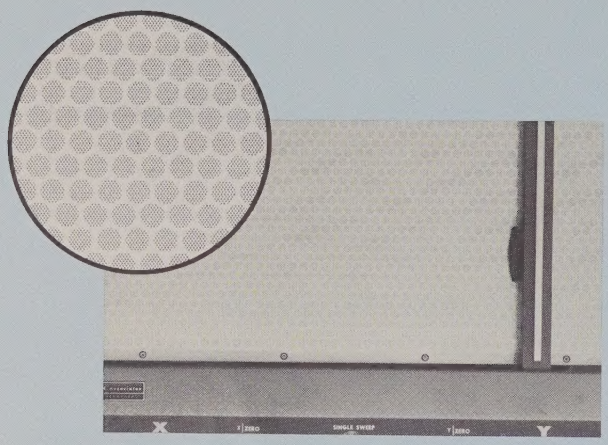
VARIAN ASSOCIATES
RECORDER DIVISION

X-Y
RECORDERS

F-80/F-81
DATA SHEET

# VARIAN MODEL F-80 X-Y RECORDER

- *Unique paper hold down system*
- *Time base with adjustable margins, automatic cycling*
- *Convenient and easy to operate*
- *Versatile and reliable*



## A VARIAN F-80 EXCLUSIVE:
### *Unique Vacuum Hold Down*

A unique method of holding the paper against the platen has been developed by Varian for its X-Y recorders. A vacuum, supplied by a quiet and maintenance-free muffin fan, holds any size or shape of chart paper securely against the perforated platen. Platen perforations are so arranged that they will not catch the pen or draw ink from it. Precision-fitted paper alignment guides and open ends facilitate loading with vacuum turned on.

## ANOTHER VARIAN F-80 EXCLUSIVE:
### *Time Sweep With Completely Adjustable Margins*

The F-80 features a built-in time sweep which provides seven selectable sweep speeds from 50 seconds/inch to 0.5 second/inch. The pen automatically lifts and returns to the lefthand margin after each sweep. Time sweeps may be initiated manually or repeated automatically. Provision is made for external triggering. When using the time sweep both margins are completely adjustable. Sweep speeds may be changed while sweeping without upsetting the plot.

### *Simple To Use*

The Varian F-80 and F-81 X-Y Recorders set a new standard of performance and convenience. These recorders feature a fresh design approach to provide the user with loading ease, simplified pen servicing, functional controls and styling. Panel controls permit operator to position plot anywhere on paper.

### *Trouble-Free Operation*

Conservative solid-state design and construction with quality components insure a long trouble-free life. One sturdy precision casting maintains alignment of all moving components. Slidewires are enclosed and the translation system uses self-aligning bearings which require no lubrication.

### *High Input Impedance*

Varian X-Y Recorders are designed to accept a wide range of inputs. Fourteen calibrated dc voltage spans from 0.5 mv/inch to 50 v/inch, plus continuous vernier adjustment, are provided. Coupling them with exceptionally high input impedance adapts the F-80 and F-81 to most input signals. Varian Recorders may be operated from signals with higher source impedance than most X-Y recorders.

### *Magnetically Controlled Pen*

The pen is attached to the carriage with a self-aligning permanent magnet. Simply touch the pen in place, it is in perfect alignment. To remove, simply lift it away. Pen operates equally well for vertical or horizontal mounting.

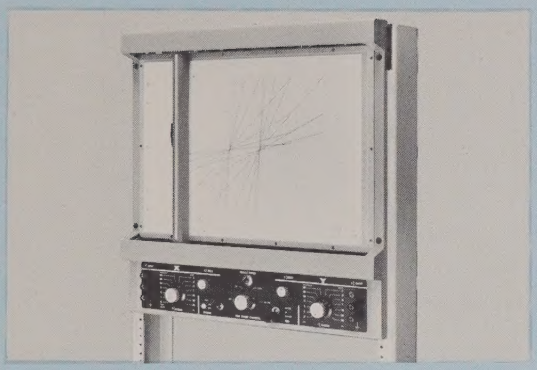
A solenoid controls pen position and maintains uniform writing pressure. An independent panel switch permits the operator to raise or lower pen and to de-energize servos when desired.

### *Custom Installation*

For custom installations, the translation and writing systems are easily separated from the control chassis, making the Varian X-Y Recorders ideal for use in test consoles, analytical instrumentation, control or monitoring stations, or other applications where bench or rack space is at a premium.

### *Accessories and Supplies*

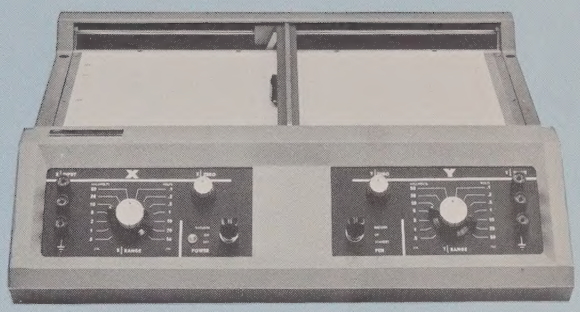
Accessories for use with the F-80 and F-81 include a rack-mounting conversion kit, retransmitting slidewire, and servicing cable kit. Chart papers and other operating supplies as well as accessories are fully described in the "Supplies and Accessories for F-80 Series X-Y Recorders" data sheet.



## AVAILABLE FOR RACK MOUNT

***Unique Tilting Control Panel***

The control panels of the Varian F-80/F-81 Recorders may be mounted in two positions. In the bench cabinet it is at a functional angle for convenience of operation. For rack mounting, the panel is rotated to a position level with the platen, shown above. Each configuration may be converted to the other by changing the trim.



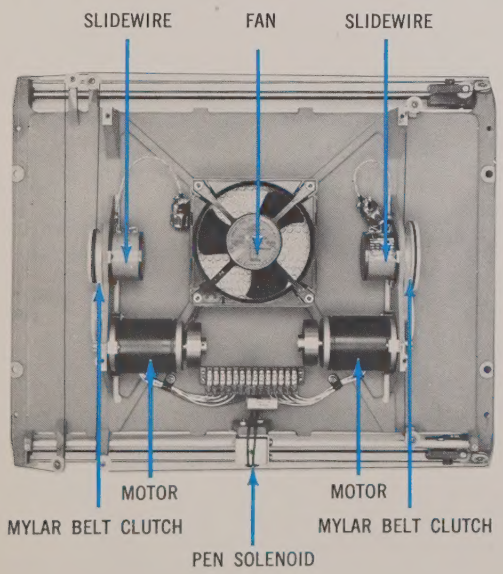
## ANOTHER VARIAN X-Y RECORDER:

***Model F-81***

The F-81 features all the performance and design advantages of the F-80 except the time base. For those not requiring a built-in time base, it offers a substantial reduction in investment while maintaining all the valuable features usually found only in high cost units. The simplified control panel makes the F-81 even easier to operate, ideal for production line testing applications.

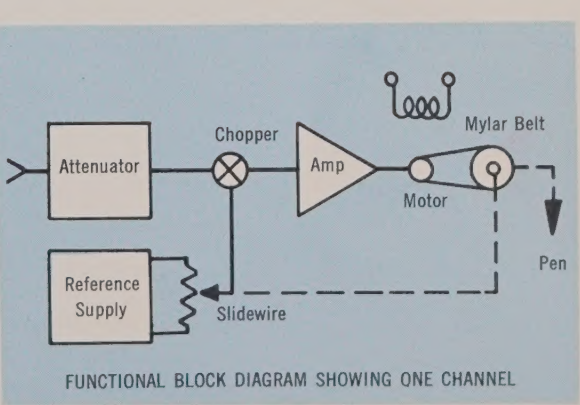
***General***

The Models F-80 and F-81 have independent servo-operated X and Y axes. Both axes use the proven null balance potentiometric principle to provide precise recordings.




Each axis consists of a precision attenuator followed by a chopper, and an a-c solid-state amplifier. The servo motor is driven push-pull from the amplifier and is mechanically coupled to the enclosed slidewire by a Mylar belt. This belt may be slipped for long periods without damage.

All moving parts and the paper hold-down system are mounted on one sturdy casting, providing extremely good reliability and ruggedness.




FUNCTIONAL BLOCK DIAGRAM SHOWING ONE CHANNEL

# F-80/F-81 SPECIFICATIONS

**Range**

Standard Models: 0.5, 1, 2, 5, 10, 20, 50, 100, 200, 500 mv/inch; 1, 10, 20, 50 v/inch, calibrated.
Metric Models: 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100, 200, 500 mv/cm and 1, 10, 20 v/cm, calibrated.
Continuously adjustable vernier between calibrated ranges.

**Input Resistance**

| STANDARD MODELS | | METRIC MODELS | |
|---|---|---|---|
| Range | Resistance | Range | Resistance |
| 0.5 mv/in | Potentiometric, virtually infinite | 0.2 mv/cm | Potentiometric, virtually infinite |
| 1.0 mv/in | 20k ohms | 0.5 mv/cm | 25k ohms |
| 2.0 mv/in | 40k ohms | 1.0 mv/cm | 50k ohms |
| 5.0 mv/in | 100k ohms | 2.0 mv/cm | 100k ohms |
| 10.0 mv/in | 200k ohms | 5.0 mv/cm | 250k ohms |
| 20.0 mv/in | 400k ohms | 10.0 mv/cm | 500k ohms |
| 50.0 mv/in | 1 megohm | 20.0 mv/cm | 1 megohm |
| 100.0 mv/in to 50.0 v/in | 2 megohm, Constant | 50.0 mv/cm to 20 v/cm | 2.5 megohm, Constant |

**Input Type**

Two independent, differential inputs. May be operated up to 200 volts, dc, above ground.

**Accuracy**

Static: 0.2% of full scale; 0.3% range-to-range.
Dynamic: 0.25% of full scale; 0.35% range-to-range (10 in/sec).

**Resetability**

0.1%

**Writing Speed**

| 60 Cycle | | 50 Cycle | |
|---|---|---|---|
| Standard Models: | 17 inches per second, each axis. | Standard Models: | 14 inches per second, each axis. |
| Metric Models: | 43 centimeters per second. | Metric Models: | 35 centimeters per second. |

**Damping**

Adjustable electrical; set for negligible overshoot for full scale step function inputs.

**Zero Adjustment**

Full scale plus 100% suppression each axis. Adjustable Y axis stop provided.

**Reference**

Internal, two independent double Zener regulated supplies.

**Platen Size**

11¾ x 17 inches (30 x 43 cm), entire area usable, precision aligned paper guides.

**Paper Hold-down**

Vacuum; supplied by quiet, maintenance-free blower fan.

**Time Base F-80 Only**

**Ranges**

Standard Models: 50, 20, 10, 5, 2, 1, 0.5 sec/inch, fixed.
Metric Models: 20, 10, 5, 2, 1, 0.5, 0.2 sec/cm, fixed.

**Functions**

Single sweep, automatic recycling, external trigger, off.

**Accuracy**

3.0% all ranges; adjustable to 1.0% on any range.

**Cycling**

Single sweep and external trigger: One sweep is made, pen lifts and resets to origin. Next sweep may be initiated after a 2-second delay.
Automatic recycling: Sweep automatically repeats after 2-second delay.

**Margins**

Origin and length of sweep are independently adjustable; providing choice of sweep duration and location. Sweep speed may be changed during sweep without resetting trace.

**Overall Size**

Bench top: 19" W x 19" D x 5¾" H (48 x 48 x 15 cm).
Rack mount: 19" W x 19¼" D x 3½" H (48 x 49 x 9 cm). Mounts in standard 19" rack.

**Weight**

35 pounds (16 kg) net.

**Power Requirements**

105-125 or 210-240 volts, ac, 60 or 50 cycle, 100 watts.

*Specifications subject to change without notice*

## ACCESSORIES

Rack-mounting conversion kit
Retransmitting slidewire (Potentiometer)
Servicing cable kit
Replacement dust cover

## SUPPLIES

Each recorder supplied with two pens, two bottles of ink (red and blue), pen cleaners and 100 sheets of 11 x 17-inch graph paper. A complete line of supplies is available for your Varian X-Y Recorder.

VARIAN ASSOCIATES RECORDER DIVISION
611 HANSEN WAY, PALO ALTO, CALIF.

INS 1507C (Printed in U.S.A. 10M664)

## 2.0 THEORY OF OPERATION

### 2.1 X-Y OPERATION

#### 2.1.1 X-CHANNEL AMPLIFIER

The X-channel amplifier circuit of the recorder is shown in schematic form on the X-Axis Amplifier Diagram that is inserted at the rear of this manual. The x-axis signal is connected to a pair of binding posts, X/INPUT + and -, on the front control panel. This input connects through a 14-step attenuator circuit. Switch S101 is positioned by the outer knob of the X/RANGE control; the inner knob connects to S108 and R101. Switch S108 is open in the CCW position of the inner knob; R101 provides continuous adjustment of the input signal level when S108 is closed.

The attenuated signal input connects through deck C of S102, the TIME SWEEP CONTROL, to chopper CH101. Chopper CH101 and transformer T104 function together to combine the d-c input and the reference d-c voltage from a slidewire. (The slidewire, R177, is mechanically coupled to servo motor B101, which is located electrically in the output of the x-axis amplifier circuit). Any voltage difference in the two voltages appears as a square wave at the base of transistor Q101. The phase of this square wave is a function of the polarity of the difference voltage. Amplifying stages Q101 through Q106 amplify the square-wave error signal and apply it to T101. The broadly resonant circuit of T101 and C106 round the signal at this point. Push-pull amplifiers Q107 and Q108 provide the energizing current for servo motor B101. C103, a back-to-back electrolytic provides further filtering of the signal at this point producing an approximate sine wave. B101 rotates in a direction corresponding to the phase of the error signal with respect to the B101 reference winding and moves the slidewire until the reference d-c and the input d-c applied to the chopper are equal. This is the action of the potentiometric servo system that positions the recorder pen with respect to the d-c input.

#### 2.1.2. Y-CHANNEL AMPLIFIER

The Y-channel amplifier circuit is practically identical to the X-channel amplifier circuit; therefore, no attempt has been made to include a schematic diagram of this circuit. The primary difference is that the attenuated Y-input signal does not pass through the TIME SWEEP CONTROL, switch S102.

## 2.2 TIME SWEEP CIRCUIT

The time sweep circuits of the F-80 are shown on a diagram entitled Sweep Circuit Diagram inserted at the rear of this manual. The circuits shown on this diagram perform two functions: (1) generation of a linear sweep voltage and (2) control of the duration of this sweep voltage.

### 2.2.1 LINEAR SWEEP VOLTAGE CIRCUIT

The linear sweep voltage is generated by charging a capacitor through a fixed attenuator circuit. A d-c voltage of +37 volts from the X-axis power supply (see paragraph 2.3.1) is applied to a voltage divider consisting of R148 and CR109. Zener diode CR109 develops a voltage of 6.8 volts; this voltage is applied to a 7-step attenuator circuit. This attenuator, R152 and C125 form an R-C time constant circuit. When the TIME SWEEP CONTROL is in any position except the OFF position, capacitor C125 charges at a rate determined by the position of the X/RANGE control. The voltage developed across C125 increases linerally until either relay K101 (S102 in the ON or EXT TRIG position) or K102 (S102 in the AUTO position) is de-energized. The operation of relays K101 and K102 are controlled by the sweep duration circuit.

The voltage develped across C125 is applied to a voltage divider consisting of R175 and R185. The portion of the linear sweep voltage developed across R185 is connected through the contacts of the TIME SWEEP CONTROL, deck C of of S102, to CH101 in the x-axis amplifier circuit. This steadily increasing voltage causes the recorder pen to move from left to right across the platen at a constant rate.

### 2.2.2 SWEEP DURATION CIRCUIT

The length of time that the linear sweep voltage is applied to the x-axis amplifier circuit is determined by the sweep duration circuit of the recorder. This circuit consists of Q109 through Q113, K101, K102 and associated components. In the ON and EXT TRIG position of the TIME SWEEP CONTROL, the action of K101 controls the duration of the sweep voltage. In the AUTO position of the TIME SWEEP CONTROL, the action of K102 controls the duration of the sweep voltage. The action of relay K101 is restricted by the action of K102 as described below.

The linear sweep voltage developed across C125 is applied through R195 to the base circuit of transistor Q113. This transistor is biased in the non-conducting state. When the sweep voltage reaches an amplitude determined by the setting of R198 (sweep width control, inner knob of TIME SWEEP CONTROL), Q113 is triggered into conduction. This in turn drives Q112 into conduction, Q111 into non-conduction and Q110 into non-conduction. Therefore, relay K102 is de-energized when the sweep voltage reaches a certain amplitude. (This amplitude corresponds to a certain distance across the platen of the recorder). When relay K102 is de-energized, relay K101 is also de-energized.

If the TIME SWEEP CONTROL is in the AUTO position, capacitor C125 is shorted when relay K102 is de-energized. The capacitor discharges rapidly reducing the sweep voltage applied to the x-axis amplifier circuit. The overall effect of de-energizing K102 is that the pen will slew back to the left edge of the platen. The pen will remain in this position for approximately two seconds, then start moving across the platen from left to right. The two second time delay is caused by Q112, Q111 and associated components which function as a one-shot multivibrator circuit. Q112, which was driven into conduction by the output of Q113, returns to the non-conducting state after approximately two seconds causing Q111 and Q110 to return to the conducting state. When Q110 starts to conduct, relay K102 is energized removing the short from capacitor C125.

If the TIME SWEEP CONTROL is in either the ON or EXT TRIG position, capacitor C125 is shorted when relay K101 is de-energized. As before, the pen is slewed from right to left across the platen to the left edge of the platen. However, the pen will remain in this position until either the SINGLE SWEEP pushbutton is depressed or the "external trigger" contacts are shorted. Either action will cause Q109 to be triggered to the conducting state. (Note that transistor Q109 cannot conduct until relay K102 is energized). When Q109 conducts, relay K101 is energized removing the short from C125 allowing the sweep voltage to build up.

## 2.3 POWER SUPPLIES

The Power Supply Diagram at the rear of this manual shows the x-axis and y-axis power supply circuits and the pen solenoid power supply circuit of the recorder.

### 2.3.1 X-AXIS POWER SUPPLY

The x-axis amplifier and the time sweep circuits are supplied by a common power supply. This power supply receives primary power when the POWER switch, S107, is in either the ON or VACUUM positions. This primary power is converted to four d-c voltages: (1) a capacitively filtered +37 volts, (2) a capacitively filtered -30 volts, (3) a zener regulated +18 volts, and (4) a double zener regulated 9 volts. All four d-c voltages are supplied to the x-axis amplifier circuit; only the +37-volt and -30-volt outputs are connected to the time sweep circuits.

### 2.3.2 Y-AXIS POWER SUPPLY

The y-axis amplifier circuit is powered by a power supply that is identical to the one that supplies power to the x-axis amplifier and time sweep circuits.

### 2.3.3 PEN SOLENOID POWER SUPPLY

Transformer T103 and associated components on the pen solenoid power supply board develop a d-c voltage of approximately 30 volts that is used to operate the pen solenoid, L101. The pen solenoid can be energized only when the PEN switch, S104, is in the RECORD position. Operation of the pen solenoid is controlled by the contacts of relay K102 (TIME SWEEP CONTROL in the OFF or AUTO position) or by the contacts of both K101 and K102 (TIME SWEEP CONTROL in the ON or EXT TRIG position). Relays K101 and K102 are controlled by the sweep duration circuit as described in paragraph 2.2.2 above.

## 3.0 F-80 OPERATION

### 3.1 DESCRIPTION AND FUNCTIONS OF CONTROLS AND JACKS

X-INPUT — Three jacks provide +, -, and chassis ground connections. The top (red) jack is +, the middle (black) jack is -, and the bottom jack is chassis ground.

X-RANGE (outer knob connects to S101 — inner knob connects to R101)

The outer control serves as both X-channel attenuator and as a time-base rate switch. All 14 positions are used for X-channel attenuation and only the first seven positions are used for time-base operation. When the F-80 is left on with open input terminals and not used, this control should be set at 1 mv/in. or higher. On the potentiometric 0.5 mv/in position the pen will drift with open input terminals.

The inner knob of the X-RANGE control serves as a vernier attenuator in X-Y operation. If calibrated attenuator input steps are required, this control is rotated to close the switch in the full CCW position, which is detented.

X-ZERO — (outer knob connects to R181 — inner knob connects to the coupled potentiometers R179 and R180)

This control sets the left-hand margin in either X-Y or time-base operation.

POWER — S107

OFF — In this position, no power is applied to the power transformers.

ON — In this position, power is applied to the transformer primarys and to the PEN switch.

VACUUM — In this position, power is applied to B103 fan creating a chart hold-down vacuum.

SINGLE SWEEP (S105 pushbutton)

This switch starts a manual sweep with the TIME SWEEP CONTROL in ON (or EXT TRIG) position.

TIME SWEEP CONTROL (outer knob) (Decks A, B, C, and D of S102)

OFF In this position all time-base circuitry is switched out for normal X-Y operation.

ON This position is provided for manual sweep which is accomplished by pressing the SINGLE SWEEP pushbutton.

AUTO In this position, the recorder automatically sweeps and resets with approximately a 2-second time delay at the reset position. The rate of sweep is adjusted by the X-RANGE outer knob in the first seven positions.

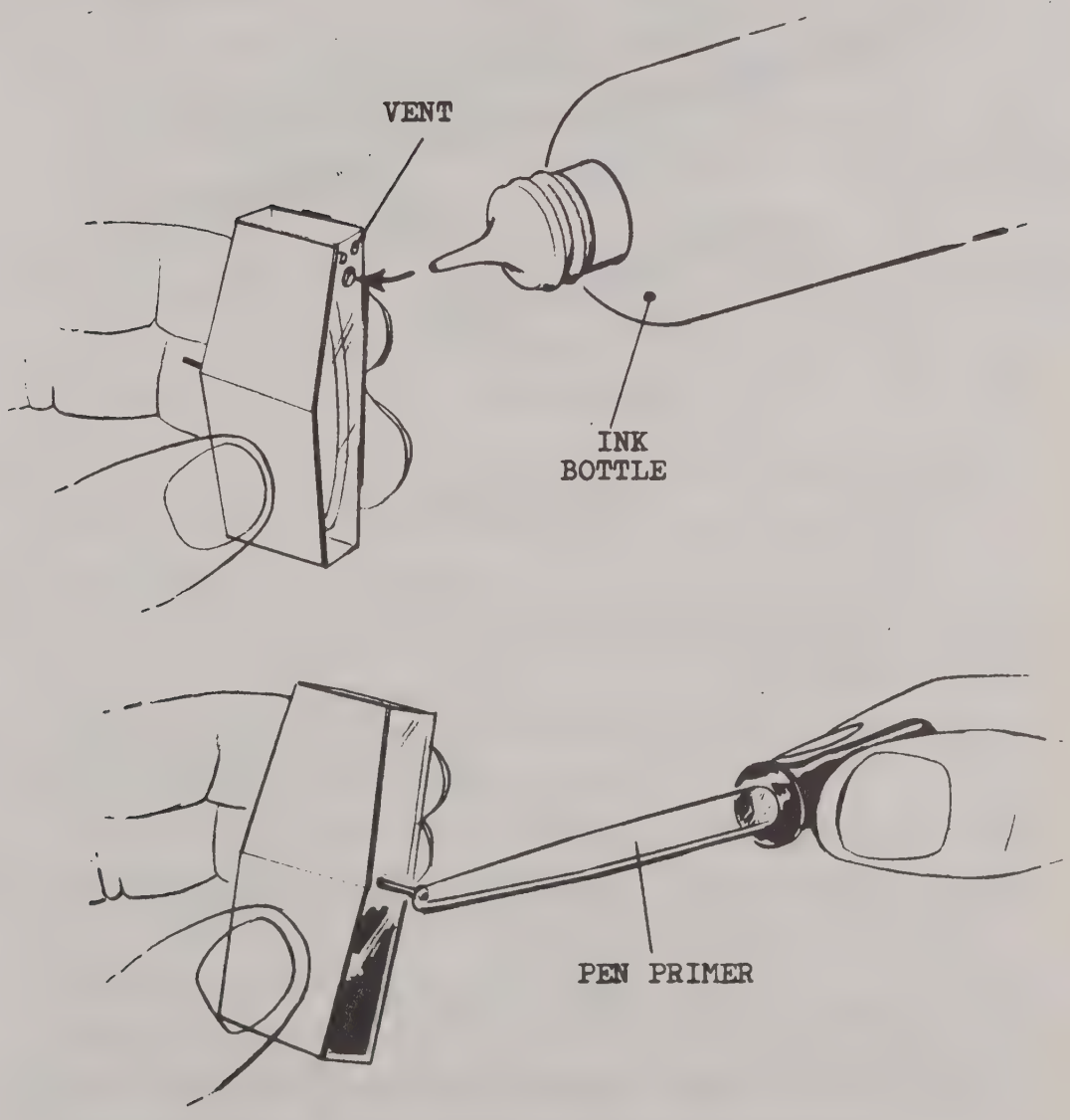
EXT TRIG In this position, the recorder can be externally triggered for a single sweep by closing the circuit connections between A and B at the external input jack at the rear or by applying a negative voltage (less than 100 volts) at A with respect to B.

TIME SWEEP CONTROL (inner knob) (R198)

The inner knob adjusts the width of the time sweep in time-base operation only.

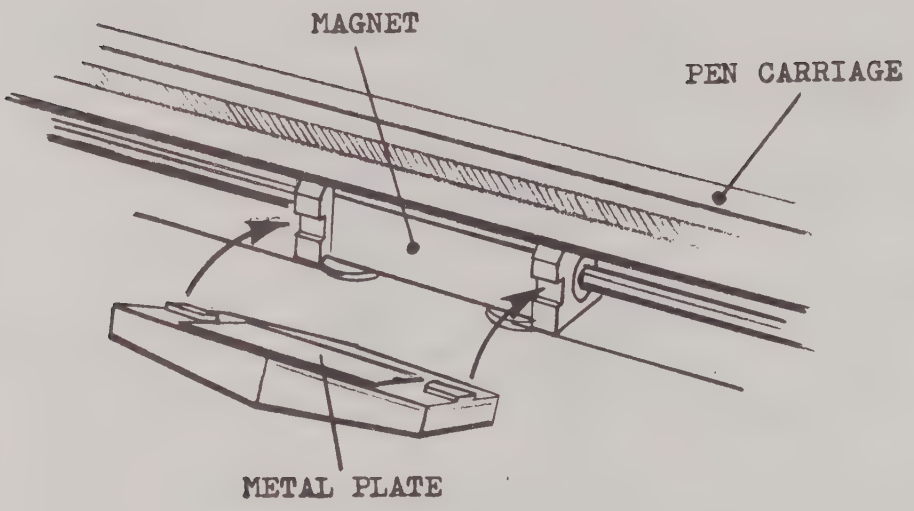
## 3.2 PRELIMINARY OPERATING STEPS

(1) Ink and prime recorder pen as shown below.




Pen Inking and Priming

(2) Place recorder pen on pen carriage as shown. (magnetically held in place)




Magnetically Held Pen

(3) Place POWER switch in the OFF position and the PEN switch at STANDBY.

(4) Connect the power cord between the 3-pin jack at the rear and a 50 or 60 cps power source as specified on the serial number tag on the base plate.

(5) Set the POWER switch at ON. The power indicator light should come on.

(6) Set the POWER switch at VACUUM.

(7) Position a sheet of the chart paper on the platen. You will notice that the vacuum holds the chart in place, but it can be re-positioned with the vacuum on. Align left hand and bottom edges of chart with guide strips on platen.

3.3 X-Y OPERATION (Complete preliminary steps first)

(1) Set the TIME SWEEP CONTROL at OFF.

(2) Connect X and Y input signals to the recorder and adjust X-RANGE and Y-RANGE controls for the approximate signal amplitudes.

(3) Set the PEN switch at UP and the recorder pen will move through the recording path without inking the chart.

(4) Set ZERO and RANGE controls for the desired presentation. For a precise presentation, it will be necessary to adjust ZERO and RANGE controls while the pen is down and actually recording.
NOTE: The aluminum knobs on the ZERO and RANGE controls provide fine adjustments. In addition, the aluminum knob on the RANGE controls is switched out at the max CCW position for calibrated range as marked.

(5) With all other controls set, the PEN control can now be placed at RECORD and the pen will drop and start inking the recording.

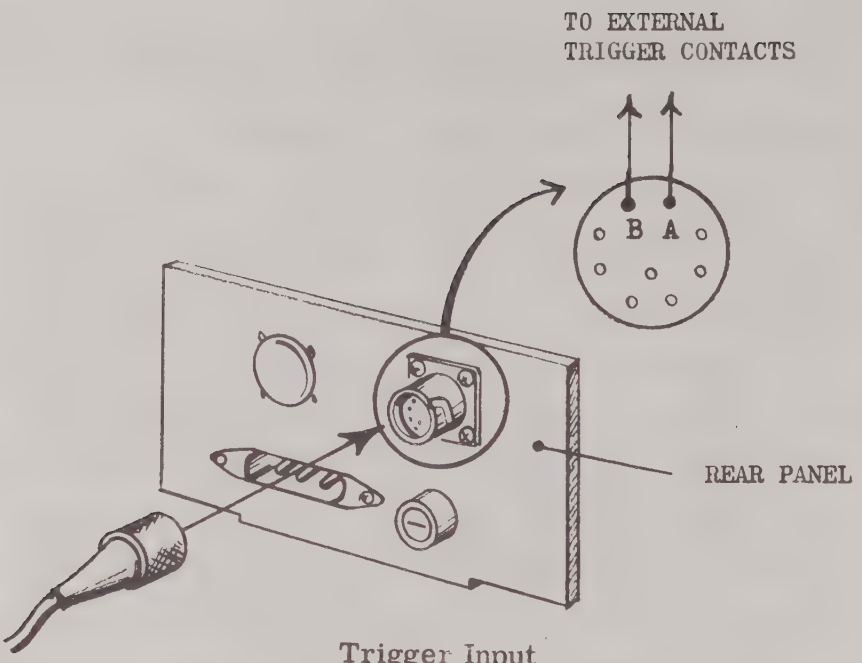
3.4 TIME-BASE RECORDING (Complete preliminary steps first)

(1) Connect the Y-input signal to the Y-INPUT jacks and set the Y-RANGE control for the approximate signal input amplitude.

(2) Place the PEN switch at UP.

(3) Set the X-RANGE control for the desired sweep rate as marked for the first seven positions of this control. (The aluminum inner knob of the X-RANGE control has no effect in time-base operation.)

(4) Set the TIME SWEEP CONTROL for ON, AUTOmatic, or EXTernal TRIGger sweep as desired. If the EXT TRIG position is used, connect the trigger signal to the pin jack at the rear of the unit as shown on following page.




Trigger Input

(5) In AUTO position, the pen will sweep at the selected time-base rate with a 2-second pause between sweeps. Set the X-ZERO control for the desired sweep start position and adjust the aluminum inner knob of the TIME SWEEP CONTROL for the desired sweep width.

(6) In the MANUAL position, the pen will make one sweep of the selected rate when the SINGLE SWEEP pushbutton is depressed. In the EXT TRIG position an external contact closure will initiate one sweep at the selected rate. Obtain sweeps in this manner and adjust X-ZERO for the desired sweep start and adjust the aluminum inner knob of the TIME SWEEP CONTROL for the desired sweep width.

(7) With all other controls set, place the PEN switch at RECORD and the pen will drop and start inking the chart when the sweep starts.

## 4.0 MAINTENANCE

Before attempting service, adjustment and maintenance of new equipment, read the warranty statement at the end of the manual and Section 4.3.1, which describes troubleshooting techniques and precautions for semiconductors.

## 4.1 PREVENTIVE MAINTENANCE

### 4.1.1 Recorder Pen Care

Recorder pens function properly when they are kept clean. Varian ink is fast drying and the ink will dry on the tip of the F-80 pen when left in the "up" position for any length of time. This film of dry ink on the pen tip can be wiped off with a paper or cloth or by dipping in water.

Inks used for the pens are water soluble. To clean ink reservoir, fill the ink container with warm water and rinse with cold water and allow to air dry. If pen is obstructed, insert the pen cleaner wire provided. Pens should be cleaned immediately after use for maximum performance.

### 4.1.2 Cleaning

Clean the pen carriage rods as often as necessary (Do Not Oil).

## 4.2 CALIBRATION

The calibrating controls in both X and Y channels are: (1) the gain adjustment, (2) the damping adjustment, and (3) the span adjustment. The time-base calibration controls are (1) the pen-offset adjustment, (2) the sweep calibrate adjustments, and (3) the linearity adjustment.

### 4.2.1 X and Y Channel Adjustments

(1) The first step in calibration is an approximate gain adjustment. Set R140 in both channels for maximum gain without oscillation.

(2) Adjust the span adjustment, R164 in each channel, for full scale deflection with a 7.5 milivolt input to the X-INPUT (and a 5 milivolt input to the Y-INPUT) with the X and Y RANGE selectors in the 0.5 mv/in position.

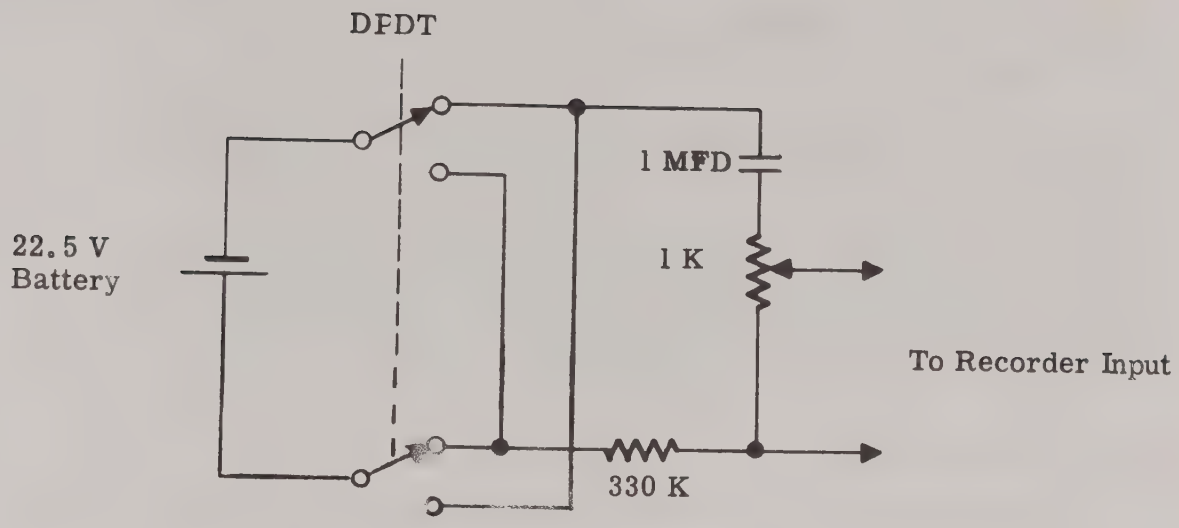
(3) Repeat step (1).

(4) Adjust the damping adjustment, R163, (R215 in the Y channel) for desired damping using a square wave input at approximately 0.1 cps.

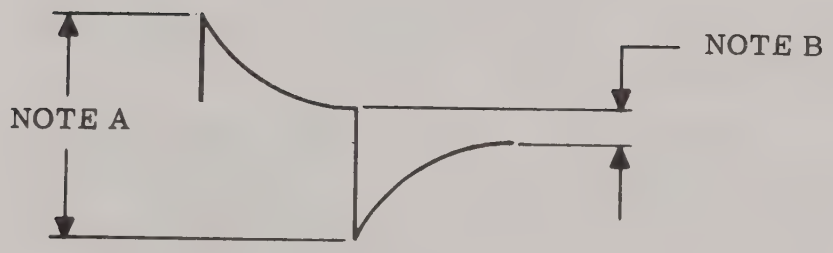
NOTE:

If a square wave generator is not available, a similar effect can be created by manually shorting an input voltage.

(5) Optimization of the gain adjustment for best sensitivity of either X or Y channels is accomplished by checking the dead zone as follows: The voltage developed across a variable resistance due to the charging current of a capacitor is connected to the input terminals by switching back and forth in a test circuit as shown in figure on following page.




TEST CIRCUIT




RECORDED PATTERN

NOTE A: Set variable resistor in test circuit for a minimum excursion of 3 inches.

NOTE B: Set amplifier gain control for a dead zone of less than 0.2% of full scale.

X-Y CHANNEL SENSITIVITY TEST CIRCUIT

### 4.2.2 TIME BASE CALIBRATION

#### 4.2.2.1 GENERAL

Prior to performing this calibration procedure, the dead zone and span of both the X and Y axes must be adjusted to their proper values. Before starting the procedure, the recorder must be removed from its case and the main recorder frame casting separated from the chassis as described in paragraph 4.3.3. The figure on page 4-19 and the fold-out schematic at the back of this manual can be used as guides in locating test points and adjustments. The X-channel signal common (-) jack should be used as the electrical ground when making the voltage and resistance measurements called out in this procedure.

#### 4.2.2.2 TEST EQUIPMENT

The following test equipment, or its equivalent, is required:

(a) John Fluke DC VTVM Model 801

(b) Hewlett-Packart Function Generator Model 202A

#### 4.2.2.3 PROCEDURE

The time base circut is calibrated as follows:

(1) Short the X and Y input terminals; then position the front panel controls as follows:

| | |
|---|---|
| POWER switch | VACUUM position |
| X-RANGE switch | 0.5 MILLIVOLTS position |
| Y-RANGE switch | 0.5 MILLIVOLTS position |
| TIME SWEEP CONTROL | OFF position |
| PEN switch | UP position |

(2) Connect the VTVM between the armature contact of Deck C of switch S101, the X-RANGE switch, and electrical ground. Adjust trimpot R147 for an indication of 2.6 volts on the VTVM.

(3) Place the X-RANGE switch in the 2 millivolts position and adjust trimpot R186 for an indication of 0.63 volts on the VTVM.

(4) Place the X-RANGE switch in the 10 MILLIVOLTS position. Adjust trimpot R302 for an indication of 0.12 volts on the VTVM.

(5) Place the X-RANGE switch in the 50 MILLIVOLTS position; then, adjust trimpot R303 for an indication of the 20 millivolts on the VTVM.

(6) Disconnect the VTVM from the recorder. Place the POWER switch in the OFF position and assemble the main recorder frame casting to the chassis and described in paragraph 4.3.3. Then, place the POWER switch in the VACUUM position. Position a sheet of chart paper on the platen; align left-hand and bottom edges of the paper with the guide strips on the platen.

(7) Place the TIME SWEEP CONTROL in the ON position, and the PEN switch in the RECORD position.

NOTE

The Y-ZERO control can be used to position the pen over a clean portion of the chart after each use.

(8) Place the X-Range switch in the 1 SEC/IN position and set the function generator to produce a 0.5 cps square wave. Depress the SINGLE SWEEP pushbutton and observe the trace being recorded. If necessary adjust trimpot R147 until seven and one-half cycles of the square wave cover fifteen inches of the chart paper plus or minus 0.45 inches (four and one-half small divisions).

(9) Place the X-RANGE switch in the 0.5 SEC/IN position and set the generator to produce a 1.0 cps square wave. Depress the SINGLE SWEEP pushbutton and observe the recorded trace. Seven and one-half cycles of the square wave should cover fifteen inches of the chart plus or minus 0.45 inches (four and one-half small divisions). If the trace is within limits, proceed to the next step. If the trace is not within limits, adjust R147 until it is within limits.

NOTE

If it is necessary to adjust R147 in step (9), repeat steps (8) and (9) until the trace is within limits in both the 1 and 0.5 SEC/IN positions of the X-RANGE switch.

(10) Place the X-RANGE switch in the 2 SEC/IN position and set the function generator to produce a 0.25 cps square wave. Depress the SINGLE SWEEP pushbutton and observe the trace being recorded. If necessary, adjust trimpot R186 until seven and one-half cycles of the square wave covers fifteen inches of the chart paper plus or minus 0.45 inches (four and one-half small divisions).

(11) Place the X-RANGE switch in the 5 SEC/IN position and set the generator to produce a 0.10 cps square wave. Depress the SINGLE SWEEP pushbutton and observe the recorded trace. Seven and one-half cycles of the square wave should cover fifteen inches of the chart plus or minus 0.45 inches (four and one-half small divisions). If the trace is within limits, proceed to the next step. If the trace is not within limits, adjust R186 until it is within limits.

NOTE

If it is necessary to adjust R186 in step (11), repeat steps (10) and (11) until the trace is within limits in both the 2 and 5 SEC/IN positions of the X-RANGE switch.

(12) Place the X-RANGE switch in the 10 SEC/IN position and set the function generator to produce a 0.05 cps square wave. Depress the SINGLE SWEEP pushbutton and observe the trace being recorded. If necessary, adjust trimpot R302 until seven and one-half cycles of the square wave covers fifteen inches of the chart paper plus or minus 0.45 inches (four and one-half small divisions).

(13) Place the X-RANGE switch in the 20 SEC/IN position and set the function generator to produce a 0.025 cps square wave. Depress the SINGLE SWEEP pushbutton and observe the trace being recorded. Seven and one-half cycles of the square wave should cover fifteen inches of the chart paper plus or minus 0.45 inches (four and one-half small divisions). If necessary, adjust trimpot R302 until the trace is within limits.

NOTE

If it is necessary to adjust R302 in step (13), repeat steps (12) and (13) until the trace is within limits in both the 10 and 20 SEC/IN positions of the X-RANGE switch.

(14) Place the X-RANGE switch in the 50 SEC/IN position and set the function generator to produce a 0.010 cps square wave. Depress the SINGLE SWEEP pushbutton and observe the trace being recorded. Seven and one-half cycles of the square wave should cover fifteen inches of the chart paper plus or minus 0.45 inches (four and one-half small divisions). Note whether the trace is within limits. If the trace is within limits, the recorder is calibrated. If the trace was not within limits, adjust R303 until the trace is within limits.

## 4.3 TROUBLESHOOTING

In case of trouble, consider the following general categories:

(1) Defective transistor resulting in low gain or no gain.

(2) Defective chopper with bad contacts resulting in a steady deflection of the pen to the right or the left (or up and down).

(3) Defective chopper with an open winding resulting in no servo control and no apparent signal response.

(4) Shorted motor capacitor resulting in no servo control or possibly a blown fuse.

(5) Defective servo potentiometer resulting in erratic pen movement.

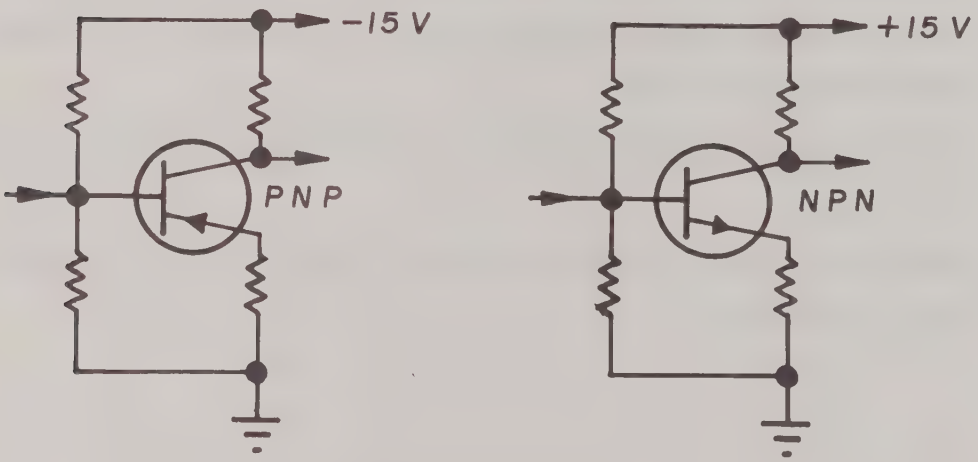
(6) Defective power supply capacitors resulting in shorted power diodes and probably a blown fuse.

(7) Defective Zener diodes resulting in loss of reference voltage or amplifier voltage.

(8) Shorted power supply diodes resulting in no pen deflection and probably a blown fuse.

### 4.3.1 Semiconductor Techniques and Precautions

Transistors, though similar in many ways to vacuum tubes, require different techniques in troubleshooting. The essential differences lie in the fact that transistors are inherently low-impedance devices operating on low voltages and small currents. Polarities depend on the type of transistor. PNP types normally require negative supply voltages. NPN types normally require positive supply voltages. Connecting the wrong voltage polarity is a sure way to break down the transistor junction.




Transistor Types

If there does not appear to be a voltage drop between emitter and collector, it can be assumed that this junction is shorted. However, it is best to turn off all voltages in the system and make a resistance check before removing the transistor from the circuit.

When checking the base-to-emitter voltage, consider that this voltage should be greater than normal if the transistor is saturated and less than normal for a cut-off condition. A saturated transistor is characterized by a low emitter-to-collector voltage. The corresponding base-to-emitter voltage would be larger than normal. However, if the transistor appears to be saturated and the base-to-emitter voltage is lower than normal, or the reverse polarity, a defective base-to-collector junction and excessive resultant leakage is indicated.

When making gain checks in transistor circuits, bear in mind that transistor voltage gains vary a great deal more than vacuum tube gains and that transistor failures are usually due to a junction breakdown, usually a "go" or "no-go" situation. Another complication is the use of d-c feedback for temperature stabilization. When one voltage in the circuit is abnormal, all circuit voltages may appear to be abnormal.

With all types of semiconductors, where sockets are not used, proper soldering techniques must be observed to avoid overheating the semiconductor junctions. To minimize excessive temperatures, (1) the semiconductor leads should be pre-tinned, (2) the terminal to which the lead is to be connected should be thoroughly cleaned, (3) a heat-sink between the transistor or diode and the joint to be made should be used to draw heat away from the semiconductor, (4) a well-tinned soldering iron should be used, and (5) the connection should be made as quickly as possible. An alligator clip or a pair of long-nose pliers make an excellent heat sink. The heat sink should be clamped to the lead as near to the diode or transistor as possible.

When applying signal voltages from a signal generator, it is essential that inputs be kept low in amplitude (under 1v preferably) in order to avoid exceeding inverse voltage breakdown limits of the transistor junction. Since transistors fail immediately when voltage breakdown values are exceeded, it is also essential that no transients be present in the transistor voltage supply.

A resistance check between transistor leads will indicate a defective transistor when there has been a junction breakdown. A junction can break down between any two connections, without necessarily being shorted to the other element. A junction breakdown is the usual case with transistors that are not functioning properly. Care should be taken when using a multimeter in checking for shorts to avoid breaking down the transistor junction with excessive current. A 100-ohm resistor should be inserted in series with the multimeter leads and 100 ohms deducted from the multimeter reading.

The circuit between any two elements of a transistor is the equivalent of a diode. Resistance checks made with the transistor out of the circuit will show a very high resistance in one direction, usually appearing as an open when measured with a multimeter, and a much lower resistance in the reverse direction.

To test a transistor still connected to the circuit, check voltages at base, emitter, and collector connections.

Voltage measurements in a transistor circuit can be misleading. If a VTVM with a grounded connection is used, and voltages are measured from ground, there will be very little difference between the base and emitter readings. The base-to-emitter voltage is usually only a few tenths of a volt. This voltage is best measured directly by a multimeter or by a VTVM that is battery powered and has no power connection to ground.

4.3.2 Voltage Checks

Refer to the schematic for voltage checks. These checks are made with X and Y inputs shorted.

4.3.3 Disassembling the F-80 for Major Servicing

(1) Remove power cord.

(2) Remove top bezel (4 screws).

(3) Remove main unit from sideframe (4 screws).

WARNING: Most testing and servicing can be accomplished without further disassembly of the disconnect unit. Steps (4) through (10) should be undertaken only when major troubleshooting is required and the accessory servicing cable has been purchased from Varian.

(4) Disconnect the two amphenol connectors located just behind the control panel (one on each side).

(5) Remove four screws from bottom of chassis to release main recorder frame casting from chassis.

(6) Carefully lift the recorder frame casting approximately 3 inches above the chassis and disconnect the 15-pin amphenol connector from the chassis (located in the center towards the rear of the unit).

(7) Lift the recorder frame casting free and set it aside.

(8) Connect the small amphenol connectors at the front of the chassis to the similar recorder frame casting connectors. Servicing extension cables are availabe at extra cost from Varian Associates.
WARNING:
The 15-pin cable must be connected properly as described below or circuit damage can result.

(9) Special care must be exercised in connecting the 15-pin extension cables between the chassis and the recorder frame casting. Check the pin letters on the extension cable (available at extra cost from Varian Associates) and mate pin A etc., to the corresponding pin A etc., on the chassis and recorder frame jacks.

(10) The unit can now be connected to line power for testing and servicing.

## 4.4 FIELD AND FACTORY SERVICE

### RECEIPT OF EQUIPMENT

Equipment should be thoroughly inspected upon receipt. If equipment is damaged in any way, a claim should be filed with the carrier. Include pertinent data on equipment and details of damage as stated in warranty. Forward one copy of the claim to Sales Manager, Recorder Products, Varian Associates.

WARNING
DO NOT ATTEMPT TO OPERATE DAMAGED
EQUIPMENT.

If equipment has received no apparent physical damage but fails to function properly, proceed as indicated below:

Address all communications regarding warranty, operation, service and parts to:

Varian Associates
Recorder Products
Service Department
611 Hansen Way
Palo Alto, California

Or to your local Varian representative (see enclosed listing). Include model, serial number, date of purchase and symptoms of problems.

### SERVICE POLICY

Varian Associates has established a policy that equipment sent in for service will be completely checked in addition to correcting the cause of the malfunction. Equipment shipped to the user will meet the specifications under which it was originally sold. When it appears that it will be unusually expensive to bring an instrument up to specifications, the Recorder Products Service Department will contact the user for specific instructions.

## WARRANTY

Recorder products manufactured by Varian Associates are warranted against defects in materials and workmanship for one year from the date of shipment. Our liability is limited to repairing or replacing parts on products (except mercury cells and vacuum tubes) which prove to be defective through no fault of the user during the warranty period.

VARIAN associates

RECORDER DIVISION

# RECORDER REPRESENTATIVES

These sales and engineering representatives are prepared to serve you promptly by providing: (1) Technical applications engineering assistance in the use of Varian Recorders. (2) Factory authorized service and calibration facilities. (3) Off-the-shelf delivery of normal operating supplies and spare parts. We encourage you to call on the organization serving your area for any of the above services.

**NEW ENGLAND STATES & EASTERN NEW YORK**

TECHNICAL INSTRUMENTS, INC.
Wilmington, Mass. 01867
122 West St.
Phone: (617) 944-3930
TWX: 617-658-3324

Bridgeport, Conn. 06604
575 Broad St.
Phone: (203) 368-4582

**NORTHERN & WESTERN NEW YORK**

RYERSON ASSOCIATES
Syracuse 1, N.Y. 13201
P.O. Box 1400
Phone: (315) 446-1771
TWX: 315-477-1132

**NEW YORK CITY, NEW JERSEY & EASTERN PENNSYLVANIA**

G. CURTIS ENGEL AND ASSOCIATES
Ridgewood, N.J.
210 S. Broad St.
Phone: New Jersey: (201) 444-1400
New York City: (212) 732-0001
Philadelphia: (215) 922-3270
TWX: 201-444-5749

**DELAWARE, MARYLAND & WASHINGTON, D.C.**

ELECTRONIC MARKETING ASSOCIATES
Wheaton, Maryland 20902
P.O. Box 1707
11411 Amherst Avenue
Phone: (301) 949-2262
TWX: (301) 949-6789

Timonium, Maryland 21093
125 Aylesbury Road
Phone: (301) 825-0300

**SOUTHEASTERN STATES**

BSC ASSOCIATES, INC.
Orlando, Florida 32803
P.O. Box 6578
1009 E. Colonial Dr.
Phone: (305) 425-2764
TWX: (305) 275-0422

Huntsville, Alabama 35805
2317 Bob Wallace Ave., S.W.
Phone: (205) 534-1648
TWX: (205) 881-1833

Greensboro, North Carolina 29405
1020 E. Wendover Avenue
Phone: (919) 273-1918
TWX: (919) 292-1057

**MICHIGAN, OHIO & WESTERN PENNSYLVANIA**

WKM ASSOCIATES, INC.
Cleveland, Ohio 44129
7710 Wainstead Dr.
Phone: (216) 885-5616

Detroit 34, Mich.
19430 Mt. Elliott
Phone: (313) 366-0840

Pittsburgh 36, Penna.
428 Torwood Lane
Phone: (412) 892-2953

Dayton 19, Ohio
3065 Far Hills Ave.
Phone: (513) 298-7203

**NORTH CENTRAL STATES**

PIVAN ENGINEERING COMPANY
Chicago, Illinois 60645
3535 W. Peterson Ave.
Phone: (312) 539-4838
TWX: 312-222-9629

Indianapolis, Indiana 46280
10447 N. College Ave.
Phone: (317) 846-5805

Minneapolis, Minnesota 55369
210 S. Fifth St.
Phone: (612) 335-3333

**SOUTH CENTRAL STATES**

ECKLUND ELECTRONIC SALES CO.
Dallas, Texas 75230
P.O. Box 30592
Phone: (214) 363-4934
REA: 621 Preston Forest Center
Dallas 30, Texas

**ROCKY MOUNTAIN STATES**

HYTRONIC MEASUREMENTS, INC.
Denver 23, Colorado 80200
1295 S. Bannock St.
Phone: (303) 733-3701
TWX: 303-292-3052

Albuquerque, N. Mex. 87100
P.O. Box 8394, Station C
225 Sierra Drive, S.E.
Phone: (505) 255-0669
TWX: (505) 243-8484

Salt Lake City, Utah 84100
2022 South Main St.
Phone: (801) 466-4924
TWX: 801-521-2685

**NORTHWESTERN STATES & ALASKA**

BURT PORTER CO.
Seattle, Wash. 98144
1209 Poplar Place S.
Phone: (206) 323-8330
TWX: 206-998-0625

Portland, Oregon
1315 S.E. 159th
Phone: (503) 253-5807

**NORTHERN CALIFORNIA & NORTHERN NEVADA**

VARIAN ASSOCIATES
Palo Alto, Calif.
611 Hansen Way
Phone: (415) 326-4000
TWX: 415-492-9395

**ARIZONA, SOUTHERN CALIF. & SOUTHERN NEVADA**

V.T. RUPP COMPANY
Los Angeles, Calif. 90026
307 Parkman Avenue
Phone: 387-8224
TWX: 213-380-8840

San Diego, Calif. 92103
3445 Fifth Avenue
Phone: 298-9835
TWX: 714-291-0736

ARIZONA
Phone: EN-1234

**HAWAII**

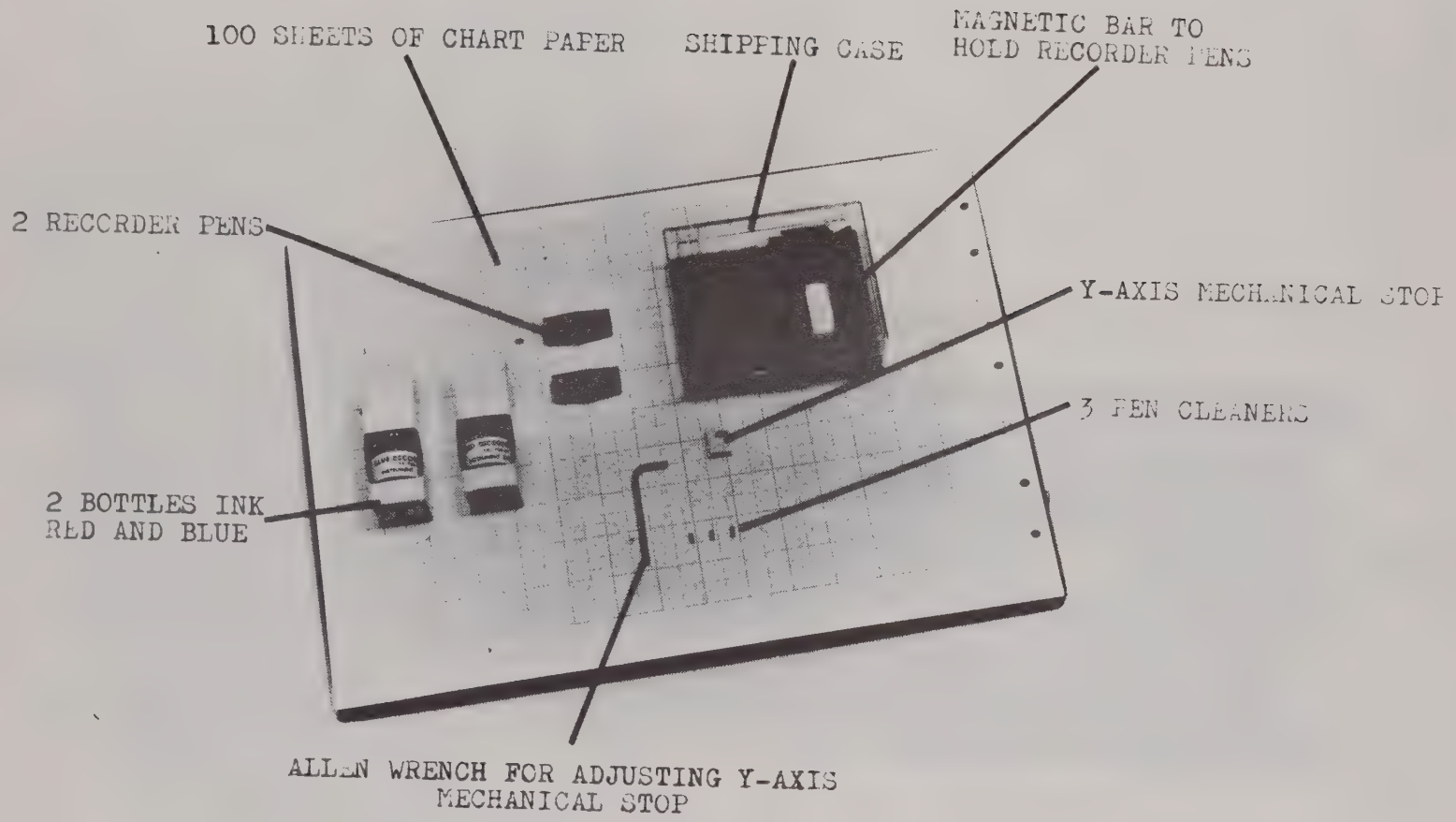
AL MICHELI
Honolulu, Hawaii
949 McCully St.

**CANADA**

R-O-R ASSOCIATES, LTD.
Don Mills, Ontario
1470 Don Mills Rd.
Phone: HIckory 4-4429
Telex 02-2508
Cables ``RORENG''

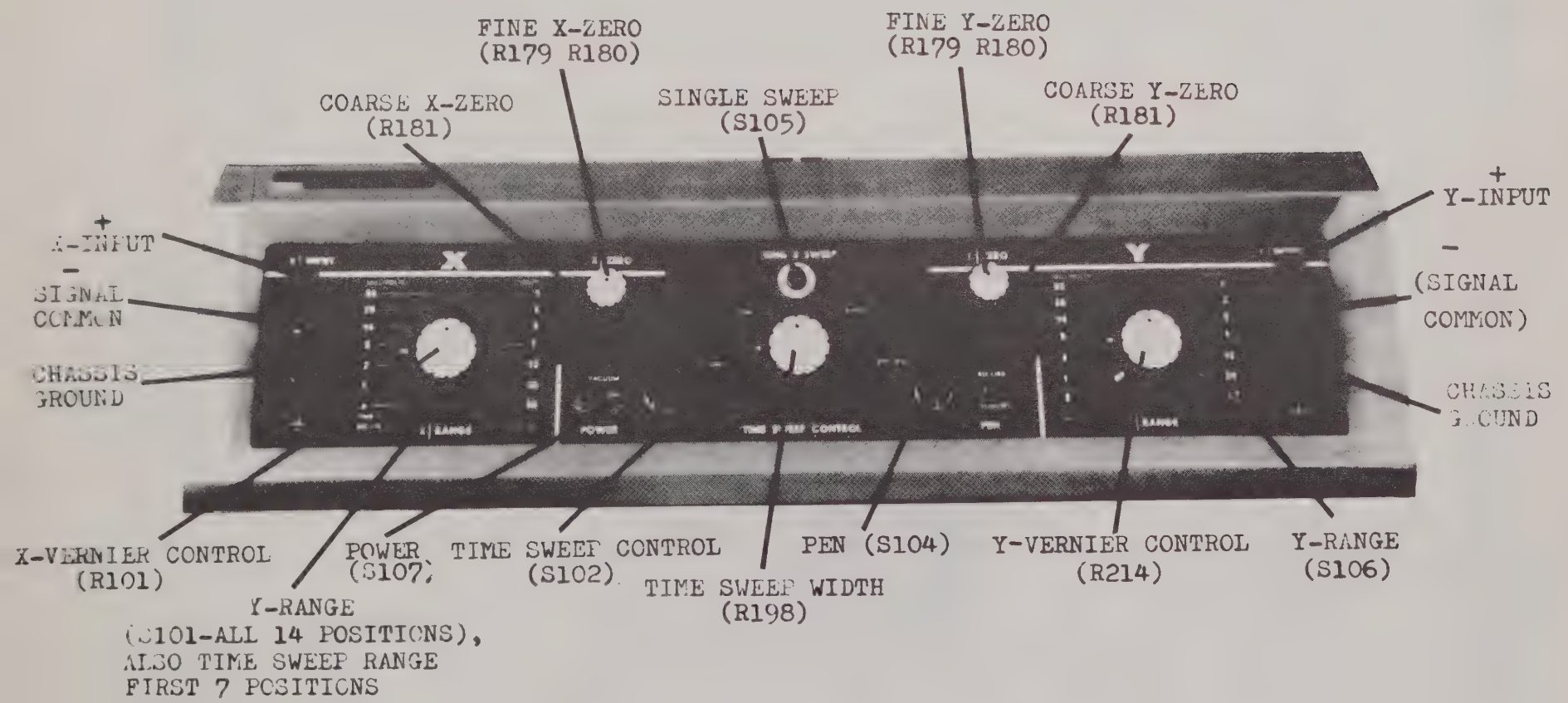
N.D.G. Montreal Quebec
3333 Cavendish Blvd.
Phone: HUnter 1-0700
Telex 01-2227

Ottawa 3, Ontario
864 Lady Ellen Place
Phone: PArkway 9-1585

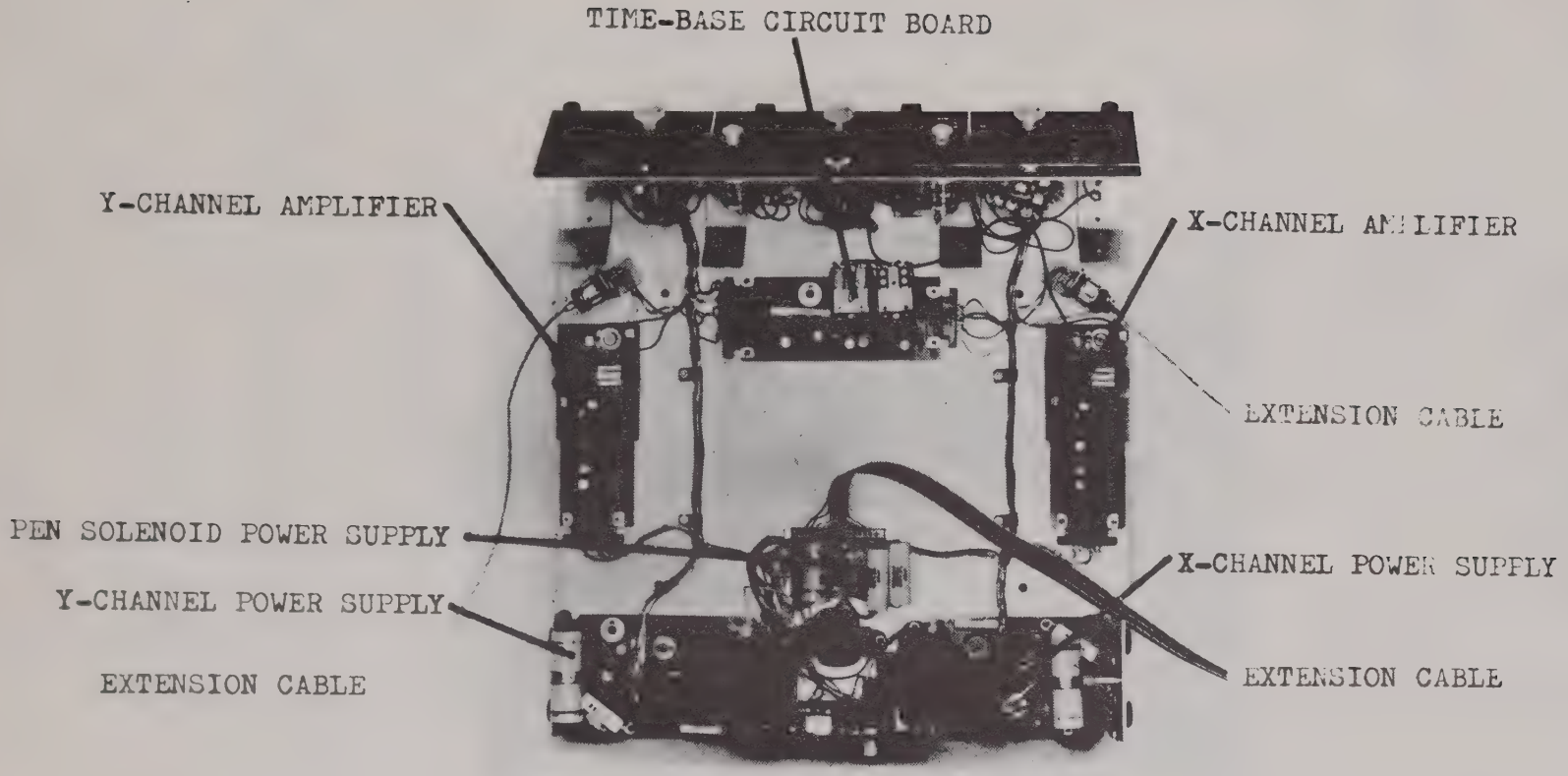

100 SHEETS OF CHART PAPER
SHIPPING CASE
MAGNETIC BAR TO HOLD RECORDER PENS
2 RECORDER PENS
Y-AXIS MECHANICAL STOP
3 PEN CLEANERS
2 BOTTLES INK RED AND BLUE
ALLEN WRENCH FOR ADJUSTING Y-AXIS MECHANICAL STOP

ITEMS SHIPPED WITH F-80 X-Y RECORDER

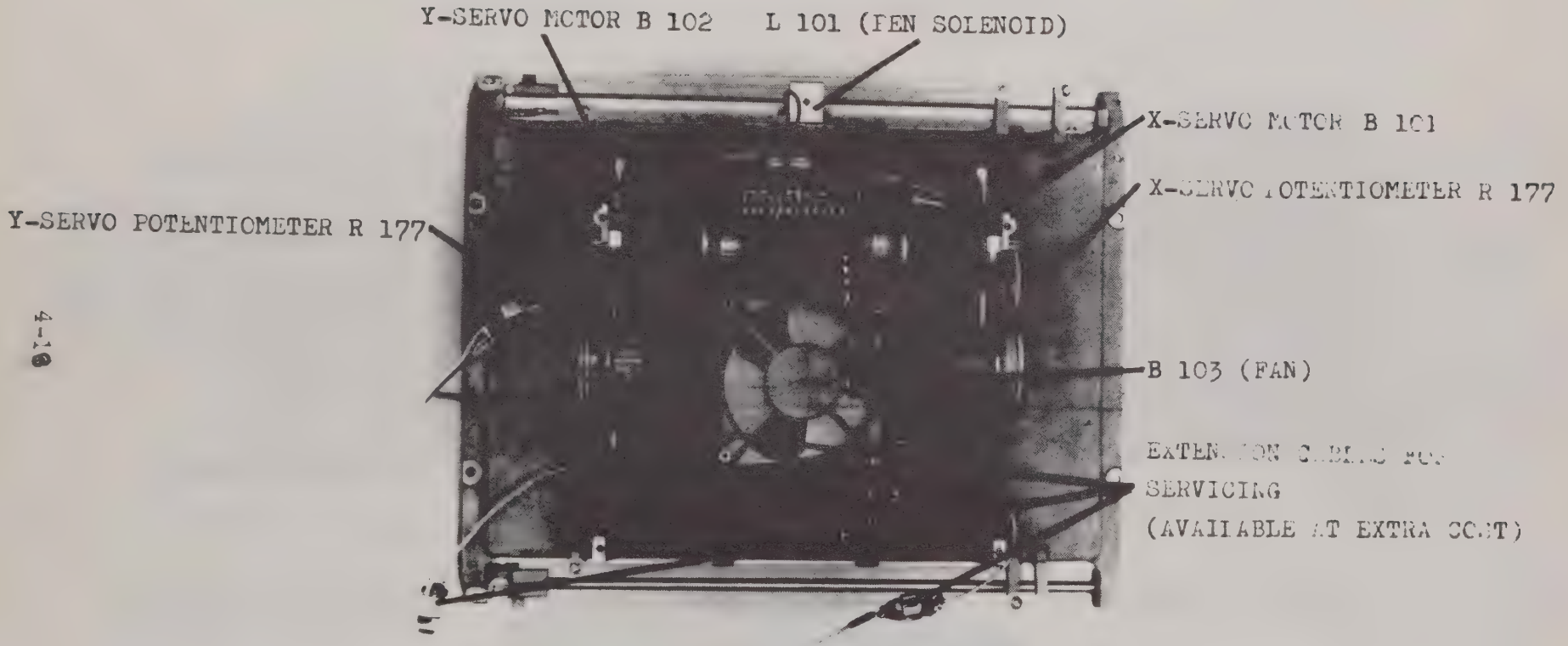
(ALSO INCLUDED ARE DUST COVER, INK PRIMER, AND POWER CORD NOT SHOWN)



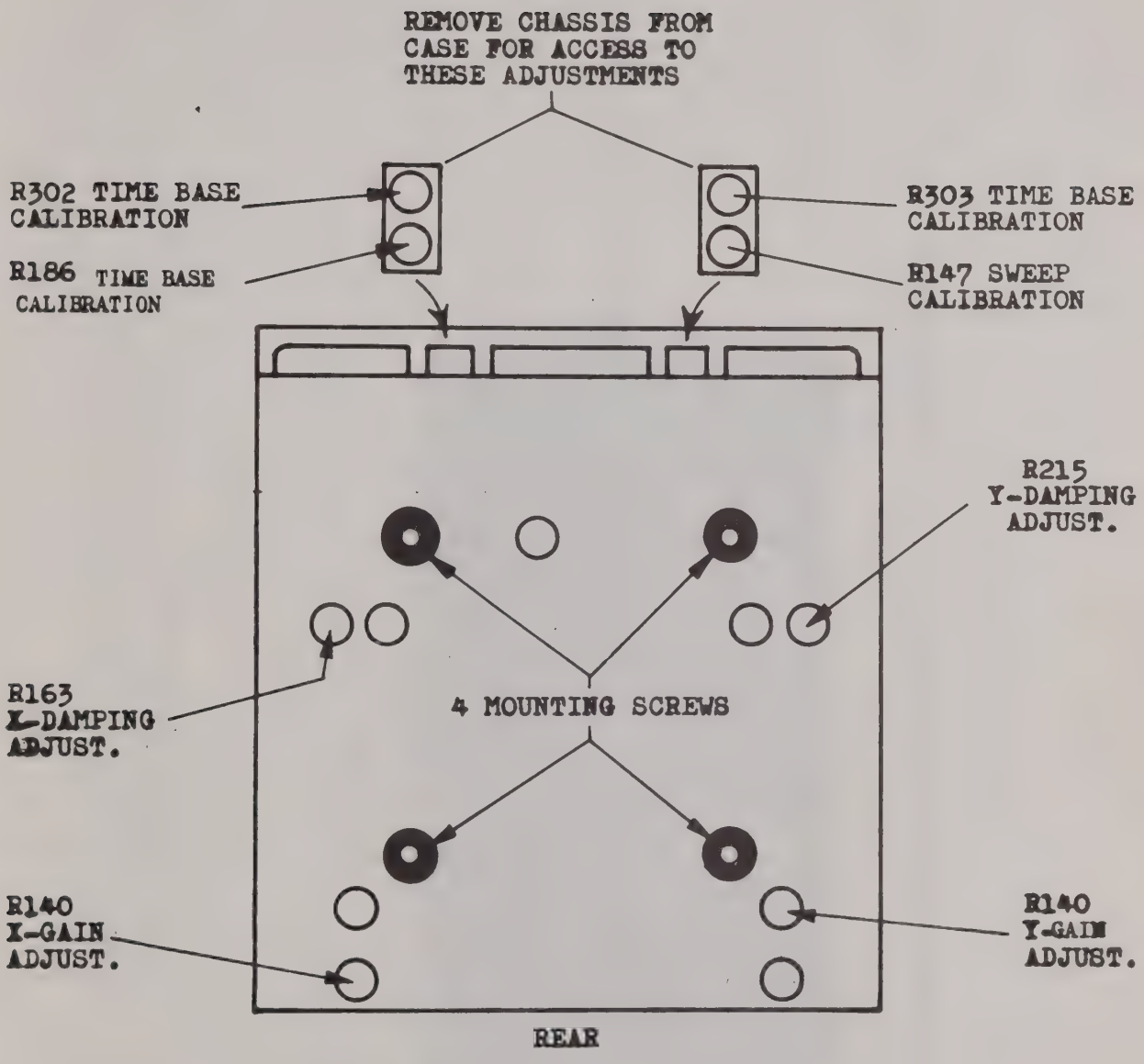

F-80 CONTROL PANEL




F-80 X-Y RECORDER CHASSIS



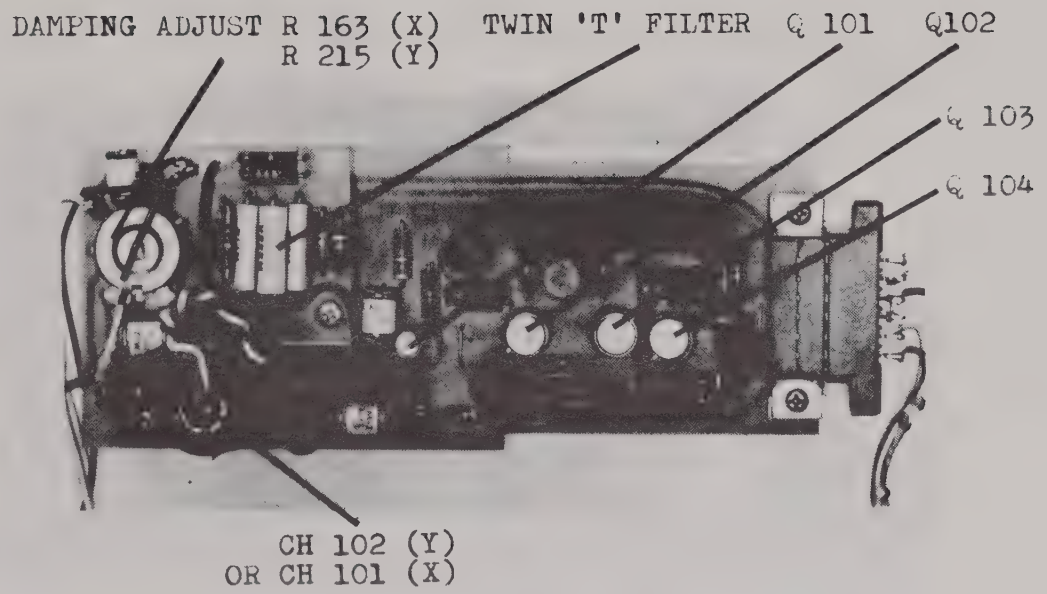

F-80 RECORDER FRAME CASTING



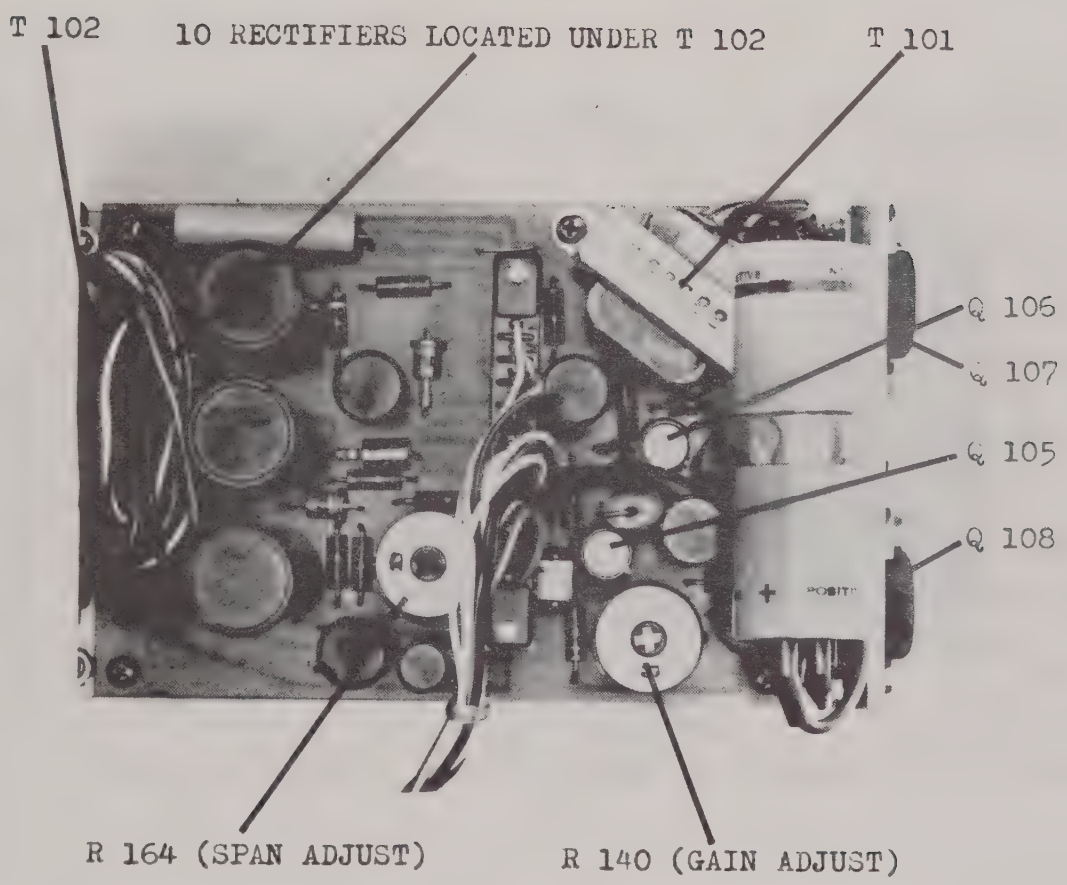

CHASSIS BOTTOM VIEW

NOTE: IN LATER MODEL UNITS, R147, R163, R186, R215, R302 and R303 ARE MOUNTED ON SPECIAL PANEL BEHIND FRONT CONTROL PANEL

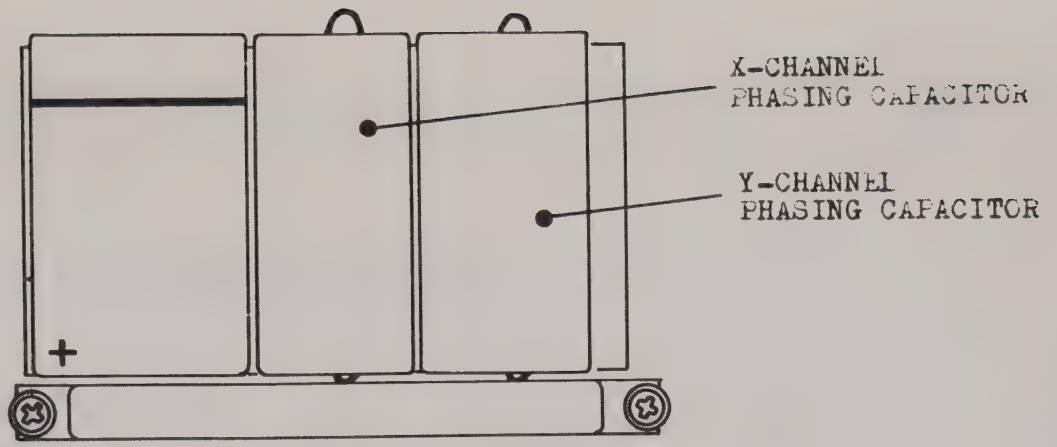
REAR CONNECTIONS




Y-CHANNEL AMPLIFIER (X-CHANNEL AMPLIFIER IDENTICAL)



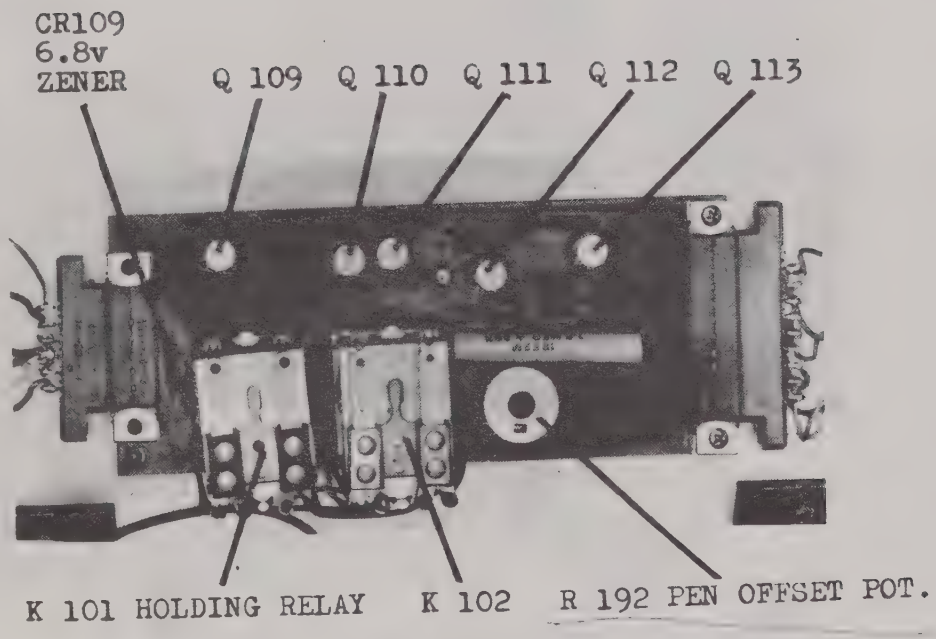

Y-CHANNEL POWER SUPPLY
(X-CHANNEL POWER SUPPLY IDENTICAL)




SERIAL NUMBER 106 AND HIGHER

SERIAL NUMBER 101 THROUGH 105

PEN SOLENOID POWER SUPPLY




TIME-BASE CIRCUIT BOARD

PHYLIS DAVIS

ENG DICK Kelly

Bob JONES

# F-80 X–Y RECORDER PRELIMINARY PARTS LIST
## 60 CYCLE UNITS – S/N 388 AND UP

RECORDER DIVISION

| Schematic Reference | Part Description | Varian Part Number |
|---|---|---|
| B101 | Motor, servo, 3500 rpm, 115 vac reference, 36 vac control, 60-cycle, single phase | 907–186 |
| B102 | Motor, servo, 3500 rpm, 115 vac reference, 36 vac control, 60-cycle, single phase | 907–186 |
| B103 | Fan, ventillating, muffin–venturi type, 100 cfm, 115 vac, 60-cycle, single phase | 20–839–930 |
| C101 | Capacitor, fixed, mylar, 0.01 mfd, 200 vdcw | |
| C102 | Capacitor, fixed, electrolytic, 25 mfd, 25 vdcw, -10 +100% | 41–506–990 |
| C103 | Capacitor, fixed, electrolytic, 50–50 mfd dual, 150–150 vdcw | 41–516–810 |
| C104 | Capacitor, fixed, electrolytic, 25 mfd, 25 vdcw, -10 +100% | 41–506–990 |
| C105 | Capacitor, fixed, electrolytic, 50 mfd, 50 vdcw, -10 +100% | 41–506–972 |
| C106 | Capacitor, fixed, plastic, 0.5 mfd, 200 vdcw | 41–729–540 |
| C107 | Capacitor, fixed, electrolytic, 140 mfd, 12 vdcw | 41–506–996 |
| C108 | Not Used | |
| C109 | Not Used | |
| C110 | Not Used | |
| C111 | Capacitor, fixed, mylar, 0.0047 mfd, 200 vdcw | |
| C112 | Capacitor, fixed, electrolytic, 50 mfd, 50 vdcw, -10 +100% | 41–506–972 |
| C113 | Capacitor, fixed, metalized mylar, 5 mfd, 300 vdcw | |
| C114 | Not Used | |
| C115 | Capacitor, fixed, electrolytic, 25 mfd, 12 vdcw | 41–506–880 |
| C116 | Capacitor, fixed, electrolytic, 50 mfd, 12 vdcw | 41–506–992 |
| C117 | Capacitor, fixed, electrolytic, 50 mfd, 12 vdcw | 41–506–992 |
| C118 | Capacitor, fixed, electrolytic, 50 mfd, 50 vdcw, -10 +100% | 41–506–972 |
| C119 | Capacitor, fixed, plastic, 1 mfd, 100 vdcw, ± 20% | 41–729–590 |
| C120 | Capacitor, fixed, electrolytic, 250 mfd, 50 vdcw, -10 +100% | 41–506–977 |
| C121 | Capacitor, fixed, plastic, 0.22 mfd, 200 vdcw, ± 20% | 41–729–560 |
| C122 | Capacitor, fixed, electrolytic, 50 mfd, 50 vdcw, -10 +100% | 41–506–972 |
| C123 | Capacitor, fixed, electrolytic, 500 mfd, 50 vdcw, -10 +100% | 41–506–979 |
| C124 | Capacitor, fixed, electrolytic, 50 mfd, 50 vdcw, -10 +100% | 41–506–972 |
| C125 | Capacitor, fixed, metalized mylar, 0.22 mfd, 200 vdcw | 907–513 |
| C126 | Capacitor, fixed, plastic, 0.033 mfd, 50 vdcw, ± 5% | 41–709–190 |

| Schematic Reference | Part Description | Varian Part Number |
|---|---|---|
| C127 | Not Used | |
| C128 | Capacitor, fixed, electrolytic, 500 mfd, 50 vdcw, -10 +100% | 41–506–979 |
| C129 | Capacitor, fixed, electrolytic, 10 mfd, 35 vdcw | 41–606–890 |
| C130 | Capacitor, fixed, electrolytic, 25 mfd, 12 vdcw | 41–506–880 |
| C131 | Capacitor, fixed, plastic, 1.5 mfd, 200 vdcw, ± 20% | 41–729–591 |
| C132 | Capacitor, fixed, ceramic, 0.02 mfd, 250 vdcw, -40 +60% | 41–229–020 |
| C133 | Capacitor, fixed, electrolytic, 250 mfd, 50 vdcw | 41–506–799 |
| C134 | Capacitor, fixed, metalized mylar, 0.5 mfd, 200 vdcw | 41–729–540 |
| C135 | Capacitor, fixed, electrolytic, 50 mfd, 50 vdcw, -10 +100% | 41–506–972 |
| C136 | Not Used | |
| C137 | Not Used | |
| C138 | Capacitor, fixed, metalized mylar, 5 mfd, 300 vdcw | |
| C139 | Capacitor, fixed, electrolytic, 40 mfd, 6 vdcw | 41–506–217 |
| C140 | Capacitor, fixed, electrolytic, 25 mfd, 6 vdcw | 41–506–215 |
| C141 | Capacitor, fixed, electrolytic, 25 mfd, 6 vdcw | 41–506–215 |
| C142 | Capacitor, fixed, mylar, 0.25 mfd, 200 vdcw | |
| C143 | Capacitor, fixed, mylar, 0.25 mfd, 200 vdcw | |
| C144 | Capacitor, fixed, mylar, 0.5 mfd, 200 vdcw | |
| CH101 | Contact modulator, 6.3 vac rms, 48–62 cycle, single phase, coil 310 ohms ± 25% at 25° C | 905–523 |
| CR101 | Crystal unit, rectifying, peak inverse current at 600 volts | 66–396–950 |
| CR102 | Crystal unit, rectifying, peak inverse current at 600 volts | 66–396–950 |
| CR103 | Crystal unit, rectifying, peak inverse current at 600 volts | 66–396–950 |
| CR104 | Crystal unit, rectifying, peak inverse current at 600 volts | 66–396–950 |
| CR105 | Crystal unit, rectifying, peak inverse current at 600 volts | 66–396–950 |
| CR106 | Crystal unit, rectifying, peak inverse current at 600 volts | 66–396–950 |
| CR107 | Crystal unit, rectifying, peak inverse current at 600 volts | 66–396–950 |
| CR108 | Crystal unit, rectifying, peak inverse current at 600 volts | 66–396–950 |
| CR109 | Crystal unit, rectifying, Zener, 6.8 v, mu | 66–300–754 |
| CR110 | Crystal unit, rectifying, silicon, 750 mu, 18v, 10% | 66–396–949 |

| Schematic Reference | Part Description | Varian Part Number |
|---|---|---|
| CR111 | Crystal unit, rectifying, peak inverse current at 600 volts | 66–396–950 |
| CR112 | Crystal unit, rectifying, peak inverse current at 600 volts | 66–396–950 |
| CR113 | Crystal unit, rectifying, Zener, glass, 9v 250 mu | 66–302–621 |
| CR114 | Crystal unit, rectifying, silicon, 750 mw, 18v, 10% | 66–396–949 |
| CR115 | Crystal unit, rectifying, peak inverse current at 600 volts | 66–396–950 |
| CR116 | Crystal unit, rectifying, peak inverse current at 600 volts | 66–396–950 |
| CR117 | Crystal unit, rectifying, peak inverse current at 600 volts | 66–396–950 |
| CR118 | Crystal unit, rectifying, type 1N91 | 66–300–091 |
| CR119 | Crystal unit, rectifying, type 1N91 | 66–300–091 |
| CR120 | Crystal unit, rectifying, type 1N91 | 66–300–091 |
| DS101 | Lamp, cartridge, incadescent, 28 vac, 0.04 amp, yellow lens | 67–499–971 |
| F101 | Fuse, 1 amp, 125v | 67–136–410 |
| K101 | Relay, hermetically sealed, two pair form C contacts | 907–589 |
| K102 | Relay, hermetically sealed, two pair form C contacts | 907–589 |
| L101 | Solenoid, dc, continuous duty, 48v, 35 oz lift, 1/16 to 3/8 inch stroke | 75–159–993 |
| Q101 | Transistor, 2N1306 | 62–901–306 |
| Q102 | Transistor, 2N1307 | 62–901–307 |
| Q103 | Transistor, 2N1306 | 62–901–306 |
| Q104 | Transistor, 2N1307 | 62–901–307 |
| Q105 | Transistor, 2N1306 | 62–901–306 |
| Q106 | Transistor, 2N1377 | 62–901–377 |
| Q107 | Transistor, 2N297A | 62–000–297 |
| Q108 | Transistor, 2N297A | 62–000–297 |
| Q109 | Transistor, 2N1377 | 62–901–377 |
| Q110 | Transistor, 2N1377 | 62–901–377 |
| Q111 | Transistor, 2N1306 | 62–901–306 |
| Q112 | Transistor, 2N1306 | 62–901–306 |
| Q113 | Transistor, TI 495 | 62–000–495 |
| R101 | See S101 | |
| R102 | Resistor, fixed, wire-wound, 10k, ± 0.1%, 1/4w | 907–315–07 |
| R103 | Resistor, fixed, wire-wound, 20k, ± 0.1%, 1/4w | 907–315–37 |

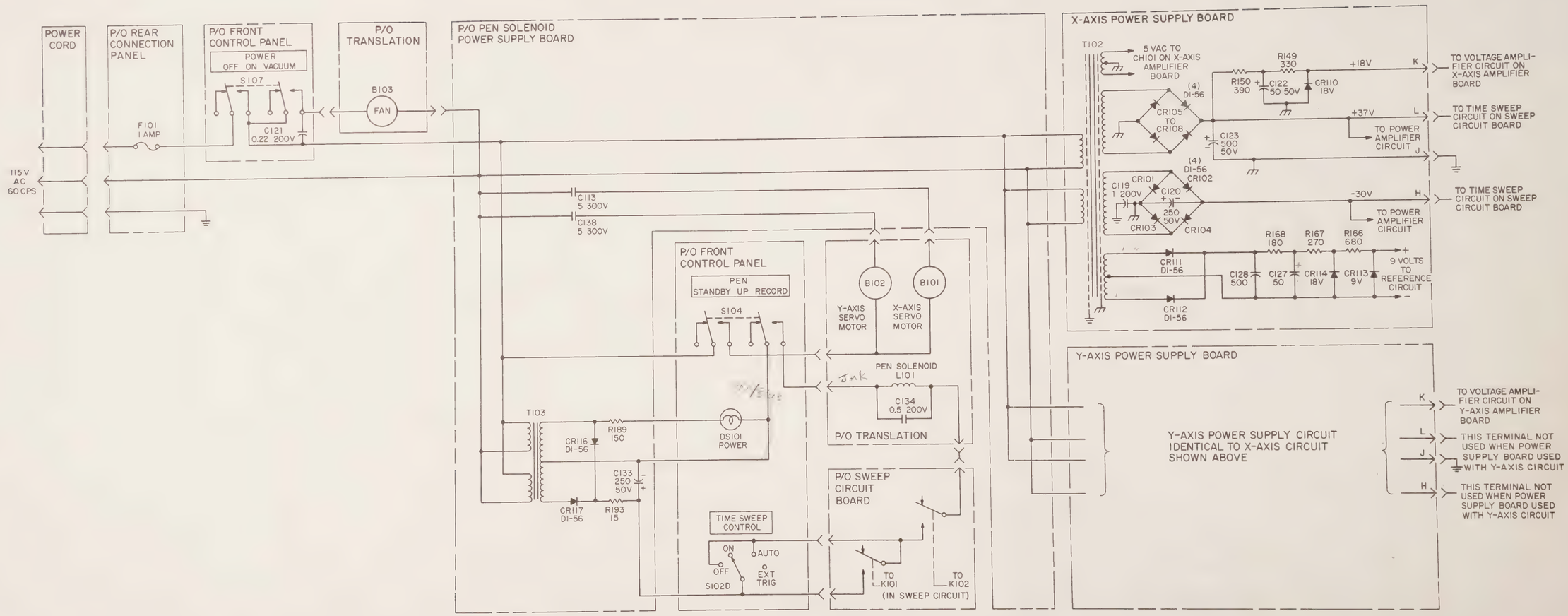
| Schematic Reference | Part Description | Varian Part Number |
|---|---|---|
| R104 | Resistor, fixed, wire-wound, 60k, ±0.1%, 1/4w | 907–315–38 |
| R105 | Resistor, fixed, wire-wound, 100k, ±0.1%, 1/4w | 907–315–04 |
| R106 | Resistor, fixed, wire-wound, 200k, ±0.1%, 1/4w | 907–315–03 |
| R107 | Resistor, fixed, wire-wound, 600k, ±0.1%, 1/4w | 907–315–02 |
| R108 | Resistor, fixed, wire-wound, 1 meg, ±0.1%, 1/4w | 907–315–01 |
| R109 | Resistor, fixed, wire–wound, 5k, ±0.1%, 1/4w | 907–315–08 |
| R110 | Resistor, fixed, wire–wound, 3k, ±0.1%, 1/4w | 907–315–09 |
| R111 | Resistor, fixed, wire–wound, 1k, ±0.1%, 1/4w | 907–315–10 |
| R112 | Resistor, fixed, wire–wound, 900 ohms, ±0.1%, 1/4w | 907–315–11 |
| R113 | Resistor, fixed, wire–wound, 50 ohms, ±0.1%, 1/4w | 907–315–12 |
| R114 | Resistor, fixed, wire–wound, 30 ohms, ±0.1%, 1/4w | 907–315–13 |
| R115 | Resistor, fixed, wire–wound, 20 ohms, ±0.1%, 1/4w | 907–315–14 |
| R116 | Resistor, fixed, composition, 150k, ±5%, 1/2w | 32–201–615 |
| R117 | Resistor, fixed, composition, 18k ohms, ±5%, 1/2w | 32–201–518 |
| R118 | Resistor, fixed, composition, 2700 ohms, ±5%, 1/2w | 32–201–427 |
| R119 | Resistor, fixed, composition, 12k, ±5%, 1/2w | 32–201–512 |
| R120 | Resistor, fixed, composition, 470 ohms, ±5%, 1/2w | 32–201–347 |
| R121 | Resistor, fixed, composition, 270k, ±5%, 1/2w | 32–201–627 |
| R122 | Resistor, fixed, composition, 270k, ±5%, 1/2w | 32–201–547 |
| R123 | Resistor, fixed, composition, 8200 ohms, ±5%, 1/2w | 32–201–482 |
| R124 | Resistor, fixed, composition, 12k, ±5%, 1/2w | 32–201–512 |
| R125 | Resistor, fixed, composition, 390 ohms, ±5%, 1/2w | 32–201–339 |
| R126 | Resistor, fixed, composition, 6800 ohms, ±5%, 1/2w | 32–201–468 |
| R127 | Resistor, fixed, wire–wound, 1 ohm, ±1%, 3w | 31–599–701 |
| R128 | Resistor, fixed, composition, 4700 ohms, ±5%, 1/2w | 32–201–447 |
| R129 | Resistor, fixed, composition, 100 ohms, ±5%, 1/2w | 32–201–310 |
| R130 | Resistor, fixed, composition, 150k, ±5%, 1/2w | 32–201–615 |
| R131 | Resistor, fixed, composition, 3300 ohms, ±5%, 1/2w | 32–201–433 |
| R132 | Resistor, fixed, composition, 6800 ohms, ±5%, 1/2w | 32–201–468 |
| R133 | Resistor, fixed, composition, 2700 ohms, ±5%, 1/2w | 32–201–427 |
| R134 | Resistor, fixed, composition, 150 ohms, ±5%, 1/2w | 32–201–315 |

| Schematic Reference | Part Description | Varian Part Number |
|---|---|---|
| R135 | Resistor, fixed, composition, 2700 ohms, ±5%, 1/2w | 32–201–427 |
| R136 | Resistor, fixed, composition, 100 ohms, ±5%, 1/2w | 32–201–310 |
| R137 | Resistor, fixed, composition, 18k ohms, ±5%, 1/2w | 32–201–518 |
| R138 | Resistor, fixed, composition, 100 ohms, ±5%, 1/2w | 32–201–310 |
| R139 | Resistor, fixed, composition, 12k, ±5%, 1/2w | 32–201–512 |
| R140 | Resistor, variable, wire–wound, 5k, ±20% | 907–337–04 |
| R141 | Resistor, fixed, composition, 22k, ±5%, 1/2w | 32–201–522 |
| R142 | Resistor, fixed, wire–wound, 2.7k, ±1%, 1/4w | 907–316–11 |
| R143 | Resistor, fixed, composition, 270k, ±5%, 1/2w | 32–201–547 |
| R144 | Resistor, fixed, composition, 12k, ±5%, 1/2w | 32–201–512 |
| R145 | Not Used | |
| R146 | Resistor, fixed, composition, 4700 ohms, ±5%, 1/2w | 32–201–447 |
| R147 | Resistor, variable, trimpot, 5k | 37–580–898 |
| R148 | Resistor, fixed, composition, 1200 ohms, ±5%, 1/2w | 32–201–412 |
| R149 | Resistor, fixed, composition, 330 ohms, ±5%, 1/2w | 32–201–333 |
| R149 | Resistor, fixed, composition, 330 ohms, ±5%, 1/2w | 32–201–333 |
| R150 | Resistor, fixed, composition, 390 ohms, ±5%, 1/2w | 32–201–339 |
| R151 | Resistor, fixed, composition, 100k, ±5%, 1/2w | 32–201–610 |
| R152 | Resistor, fixed, wire–wound, 1 meg, ±1%, 1/4w | 907–316–08 |
| R153 | Resistor, fixed, wire–wound, 500 ohms, ±1%, 1/4w | 907–316–01 |
| R154 | Resistor, fixed, wire–wound, 250 ohms, ±1%, 1/4w | 907–316–02 |
| R155 | Resistor, fixed, wire–wound, 150 ohms, ±1%, 1/4w | 907–316–03 |
| R156 | Resistor, fixed, wire–wound, 100 ohms, ±1%, 1/4w | 907–316–17 |
| R157 | Resistor, fixed, wire–wound, 25 ohms, ±1%, 1/4w | 907–316–05 |
| R158 | Resistor, fixed, wire–wound, 25 ohms, ±1%, 1/4w | 907–316–05 |
| R159 | Resistor, fixed, wire–wound, 10 ohms, ±1%, 1/4w | 907–316–07 |
| R160 | Resistor, fixed, composition, 270k, ±5%, 1/2w | 32–201–627 |
| R161 | Resistor, fixed, composition, 10k, ±5%, 1/2w | 32–201–510 |
| R162 | Resistor, fixed, composition, 1500 ohms, ±5%, 1/2w | 32–201–415 |
| R163 | Resistor, variable, trimpot, 500k | |

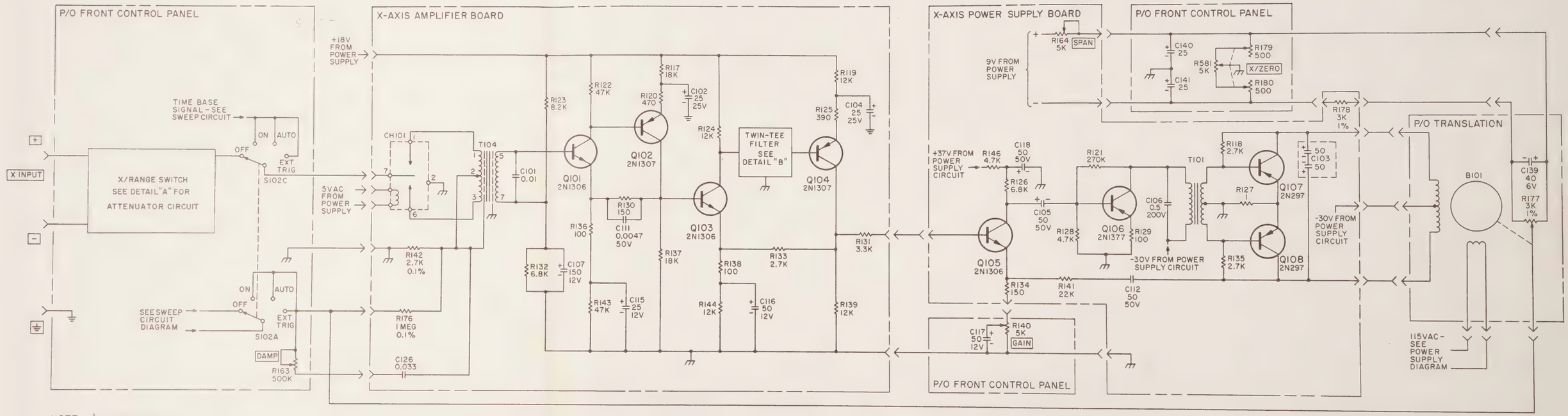
| Schematic Reference | Part Description | Varian Part Number |
|---|---|---|
| R164 | Resistor, variable, wire–wound, 5k, ±20% | 907–337–04 |
| R165 | Not Used | |
| R166 | Resistor, fixed, composition, 680 ohms, ±5%, 1/2w | 32–201–368 |
| R167 | Resistor, fixed, composition, 270 ohms, ±5%, 1/2w | 32–201–327 |
| R168 | Resistor, fixed, composition, 180 ohms, ±5%, 1/2w | 32–201–318 |
| R169 | Resistor, fixed, composition, 10k, ±5%, 1/2w | 32–201–510 |
| R170 | Resistor, fixed, composition, 100 ohms, ±5%, 1/2w | 32–201–310 |
| R171 | Resistor, fixed, deposited carbon, 5110 ohms, ±1%, 1/4w | 31–624–511 |
| R172 | Resistor, fixed, composition, 390k, ±5%, 1/2w | 32–201–639 |
| R173 | Resistor, fixed, deposited carbon, 5110 ohms, ±1%, 1/4w | 31–624–511 |
| R174 | Resistor, fixed, composition, 22k, ±5%, 1/2w | 32–201–522 |
| R175 | Resistor, fixed, wire–wound, 1 meg, ±1%, 1/4w | 907–316–08 |
| R176 | Resistor, fixed, wire–wound, 1 meg, ±1%, 1/4w | 907–316–08 |
| R177 | Resistor, variable, three–turn, 3k, ±10% | 906–549 |
| R178 | Resistor, fixed, wire–wound, 3k, ±1%, 1/4w | 907–316–15 |
| R179 | Resistor Assembly, two 500 ohm and one 5000 ohm variable resistors, ganged and interconnected | 906–745 |
| R180 | Resistor Assembly, two 500 ohm and one 5000 ohm variable resistors, ganged and interconnected | 906–745 |
| R181 | Resistor Assembly, two 500 ohm and one 5000 ohm variable resistors, ganged and interconnected | 906–745 |
| R182 | Resistor, fixed, composition, 56k, ±5%, 1/2w | 32–201–556 |
| R183 | Resistor, fixed, composition, 100k, ±5%, 1/2w | 32–201–610 |
| R184 | Resistor, fixed, composition, 560 ohms, ±5%, 1/2w | 32–201–356 |
| R185 | Resistor, fixed, wire–wound, 7.5k ohms, ±1%, 1/4w | 907–316–16 |
| R186 | Resistor, variable, trimpot, 5k | 37–580–898 |
| R187 | Resistor, fixed, composition, 68k, ±5%, 1/2w | 32–201–568 |
| R188 | Resistor, fixed, composition, 12k, ±5%, 1/2w | 32–201–512 |
| R189 | Resistor, fixed, composition, 150 ohms, ±5%, 1/2w | 32–201–315 |
| R190 | Resistor, fixed, composition, 510 ohms, ±5%, 1/2w | 32–201–351 |
| R191 | Not Used | |
| R192 | Not Used | |
| R193 | Resistor, fixed, composition, 15 ohms, ±5%, 2w | 34–401–215 |
| R194 | Resistor, fixed, deposited carbon, 3k, ±1/2%, 1/2w | 31–684–430 |

| Schematic Reference | Part Description | Varian Part Number |
|---|---|---|
| R195 | Resistor, fixed, wire–wound, 1 meg, ±1%, 1/4w | 907–316–08 |
| R196 | Not Used | |
| R197 | Resistor, fixed, composition, 1 meg, ±5%, 1/2w | 32–201–710 |
| R198 | Not Used | |
| R199 | Resistor, fixed, composition, 100k, ±5%, 1/2w | 32–201–610 |
| R200 | Resistor, fixed, wire-wound, 20k, ±0.1%, 1/4w | 907–315–37 |
| R201 | Resistor, fixed, wire-wound, 60k, ±0.1%, 1/4w | 907–315–38 |
| R202 | Resistor, fixed, wire-wound, 100k, ±0.1%, 1/4w | 907–315–04 |
| R203 | Resistor, fixed, wire-wound, 10k, ±0.1%, 1/4w | 907–315–07 |
| R204 | Resistor, fixed, wire-wound, 200k, ±0.1%, 1/4w | 907–315–03 |
| R205 | Resistor, fixed, wire-wound, 600k, ±0.1%, 1/4w | 907–315–02 |
| R206 | Resistor, fixed, wire-wound, 1 meg, ±0.1%, 1/4w | 907–315–01 |
| R207 | Resistor, fixed, wire–wound, 5k, ±0.1%, 1/4w | 907–315–08 |
| R208 | Resistor, fixed, wire–wound, 3k, ±0.1%, 1/4w | 907–315–09 |
| R209 | Resistor, fixed, wire–wound, 1k, ±0.1%, 1/4w | 907–315–10 |
| R210 | Resistor, fixed, wire–wound, 900 ohms, ±0.1%, 1/4w | 907–315–11 |
| R211 | Resistor, fixed, wire–wound, 50 ohms, ±0.1%, 1/4w | 907–315–12 |
| R212 | Resistor, fixed, wire–wound, 30 ohms, ±0.1%, 1/4w | 907–315–13 |
| R213 | Resistor, fixed, wire–wound, 20 ohms, ±0.1%, 1/4w | 907–315–14 |
| R214 | See S106 | |
| R215 | Not Used | |
| R216 | Not Used | |
| R217 | Not Used | |
| R300 | Not Used | |
| R301 | Resistor, fixed, wire–wound, 1k, ±1%, 1/4w | 907–316–18 |
| R302 | Resistor, variable, trimpot, 5k | 37–580–898 |
| R303 | Resistor, variable, trimpot, 5k | 37–580–898 |
| R304 | Resistor, fixed, wire–wound, 1k, ±1%, 1/4w | 907–316–18 |
| R305 | Not Used | |
| R306 | Not Used | |
| R307 | Not Used | |
| R308 | Not Used | |
| R309 | Resistor, fixed, composition, 5600 ohms, ±5%, 1/2w | 32–201–456 |
| R310 | Resistor, fixed, composition, 5600 ohms, ±5%, 1/2w | 32–201–456 |
| R311 | Resistor, fixed, composition, 3k, ±5%, 1/2w | 32–201–430 |
| R312 | Resistor, fixed, composition, 47k, ±5%, 1/2w | 32–201–547 |
| R313 | Resistor, fixed, composition, 47k, ±5%, 1/2w | 32–201–547 |
| R314 | Resistor, fixed, composition, 47k, ±5%, 1/2w | 32–201–547 |
| 315 | Resistor, fixed, composition, 47k, ±5%, 1/2w | 32–201–547 |

| Schematic Reference | Part Description | Varian Part Number |
|---|---|---|
| S101 | Switch Assembly, three-pole fourteen-position wafer switch, and 500k variable resistor with single-pole single-throw switch | 906–747 |
| S102 | Switch Assembly, four-pole four position wafer switch, 1k variable resistor, and dummy deck with five terminals | 906–746 |
| S103 | Not Used | |
| S104 | Switch, telephone type, three-position, two form C contacts | 907–314 |
| S105 | Switch, single-pole, single-throw, momentary contact | 907–313 |
| S106 | Switch Assembly, three-pole fourteen-position wafer switch, and 500k variable resistor with single-pole single-throw switch | 906–747 |
| S107 | Switch, telephone type, three-position, two form C contacts | 907–314 |
| S108 | See S101 | |
| S109 | See S109 | |
| T101 | Transformer, interstage | 962–688 |
| T102 | Transformer, power | 907–206 |
| T103 | Transformer, power | 907–200 |
| T104 | Transformer, input | 907–530 |




60-CYCLE RECORDER POWER SUPPLY DIAGRAM

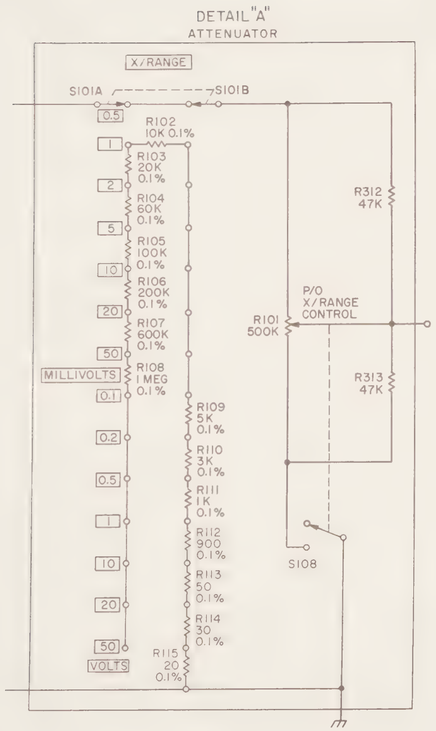


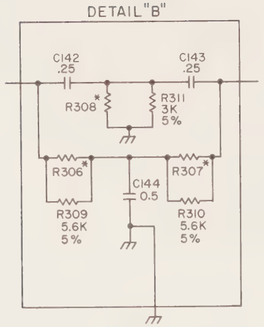

NOTE: ⏚ CHASSIS GROUND

⏥ SIGNAL GROUND ISOLATED (DC) FROM CHASSIS GROUND

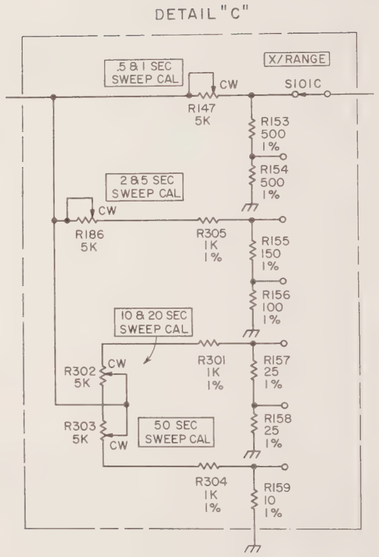
Replaced Y-axis pot — meter 3-24-61 FK

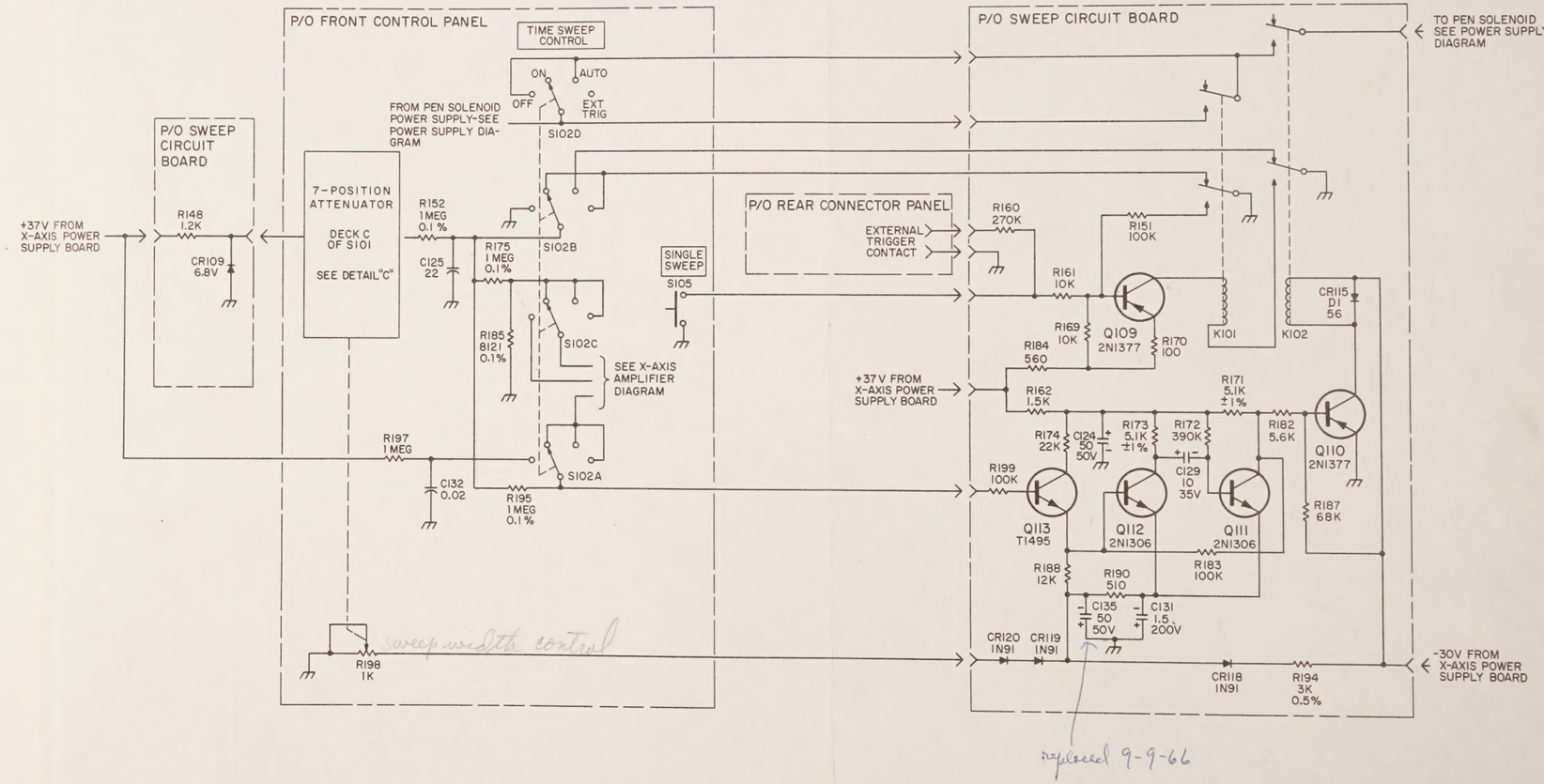
X-AXIS AMPLIFIER DIAGRAM




* FACTORY SELECTED






SWEEP CIRCUIT DIAGRAM

John Hunt
537-5422

11-21-78
Parts if # known
800 538 1735

www.manualsplus.com
1034856

Recorder Division

VARIAN associates
PALO ALTO, CALIFORNIA

415-493-4000